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Publications of the United States National Museum

The scientific publications of the United States National Museum include two series, *Proceedings of the United States National Museum* and *United States National Museum Bulletin*.

In these series are published original articles and monographs dealing with the collections and work of the Museum and setting forth newly acquired facts in the fields of anthropology, biology, geology, history, and technology. Copies of each publication are distributed to libraries and scientific organizations and to specialists and others interested in the various subjects.

The *Proceedings*, begun in 1878, are intended for the publication, in separate form, of shorter papers. These are gathered in volumes, octavo in size, with the publication date of each paper recorded in the table of contents of the volume.

In the *Bulletin* series, the first of which was issued in 1875, appear longer, separate publications consisting of monographs (occasionally in several parts) and volumes in which are collected works on related subjects. *Bulletins* are either octavo or quarto in size, depending on the needs of the presentation. Since 1902 papers relating to the botanical collections of the Museum have been published in the *Bulletin* series under the heading *Contributions from the United States National Herbarium*.

FRANK A. TAYLOR,
Director, United States National Museum.

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SCARAB BEETLES OF THE GENUS ONTHOPHAGUS LATREILLE NORTH OF MEXICO (COLEOPTERA: SCARABAEIDAE)

By HENRY F. HOWDEN *and* OSCAR L. CARTWRIGHT

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SCARAB BEETLES OF THE GENUS ONTHOPHAGUS LATREILLE NORTH OF MEXICO (COLEOPTERA: SCARABAEIDAE)

HENRY F. HOWDEN[1] and OSCAR L. CARTWRIGHT[2]

The purpose of this paper is to facilitate the identification of the species of *Onthophagus* of the United States and Canada and to present information on their habits and life histories. Twenty-three species and subspecies described from North America, two species introduced from Europe and Africa, and eleven previously unrecognized species are included. A key to the species, bibliographical references, complete new descriptions, photographs of both sexes, and maps of distribution are given. Important nomenclatural changes are presented.

Acknowledgments

As a staff member of the University of Tennessee, Howden was encouraged to make four field trips to Florida and Alabama to study distribution and biology of the group. Later the Entomology Research Institute of Canada supported three trips to Texas, Arizona, and Mexico in 1958, 1959, and 1960. The Smithsonian Institution sent Cartwright, as a staff member of the United States National Museum, to study types at the Museum of Comparative Zoology at

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Harvard, the Academy of Natural Sciences of Philadelphia, and Purdue University at Lafayette, Ind. Through the assistance of the American Philosophical Society, longer field trips were made by Howden to Texas in 1954 and Arizona in 1956, and by Cartwright to Arizona in 1956. We are grateful for this support.

We also acknowledge our indebtedness and extend our thanks to numerous institutions and individuals for the generous loan of specimens. The letters in parentheses in the following list of collections studied are abbreviations used in the text when citing material; the name of the curator responsible for the loan of the specimens follows the abbreviation: Academy of Natural Sciences of Philadelphia (ANSP), J. A. G. Rehn; American Museum of Natural History (AMNH), Mont A. Cazier; California Academy of Sciences (CAS), H. B. Leech; Canadian National Collection (CNC), W. J. Brown; Carnegie Museum, G. E. Wallace; Chicago Natural History Museum (CNHM), Henry S. Dybas; Cornell University (CU), Henry Dietrich; Illinois Natural History Survey (INHS), M. W. Sanderson; Iowa State College (IS), J. L. Laffoon; Museum of Comparative Zoology (MCZ), P. J. Darlington; Ohio State University (OSU), J. N. Knull; Oregon State College (OSC), P. O. Ritcher; San Jose State College, J. Gordon Edwards; United States National Museum (USNM); University of Arizona (UA), Floyd Werner; University of California, Davis (UCD), A. T. McClay; University of Kansas (UKA), R. H. Beamer; University of Michigan (UMich.), T. H. Hubbell; University of Nebraska, W. T. Atyeo; University of Texas (UTEX), H. J. Reinhard; University of Tennessee (UT); and Utah State Agricultural College, G. F. Knowlton.

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Mrs. Anne Howden aided the project in many ways, both in the field and in the typing of the manuscript. Photographs were taken by Jack Scott of the Smithsonian staff.

Review of literature

The genus *Onthophagus* was established by Latreille in 1802. Since that time parts of the genus have received considerable attention. The American species north of Mexico were discussed by Horn in 1875. In this work he listed only five species; actually he included five species under one of these names and started much of the confusion of later authors. In 1881, he described three more. In 1887, Bates described and listed many of the species occurring in Mexico and in Central and South America. In Blatchley's 1910 work on the Coleoptera of Indiana, eight species and varieties are listed; incorrect placement of several of these continued and compounded the subsequent confusion. In 1914, Schaeffer included 18 species in "A Short Review of the North American Species of *Onthophagus*," the most recent comprehensive paper on the American species north of Mexico. The list of the *Onthophagus* of the world published by Boucomont and Gillet in 1927 greatly facilitated the study of the group. Subsequently a number of new North American species were described by Brown (1927; 1929a; 1929b). These papers were followed by a synopsis of the Mexican and Central and South American species by Boucomont in 1932. Boucomont's paper was intended to be used mainly to identify the Mexican and South American forms, but the inclusion of many species from the United States, in both keys and footnotes, made it useful for all the Americas.

The habits of our North American species are still almost unknown. Sim, in 1930, discussed the habits of *Onthophagus subaeneus* (under the name *cribricollis*). In 1935, Lindquist mentioned some of the habits of *O. pennsylvanicus* and *O. alluvius* (under *anthracinus*). A few additional observations on *O. pennsylvanicus* and *O. hecate* were included in Miller's 1954 paper on dung beetles.

The only descriptive work on the immature stages of North American *Onthophagus* was published by Ritcher in 1945. In this work on the larvae of the Coprinae of eastern North America, he described in detail the larvae of *O. hecate* and *O. pennsylvanicus*. He also gave a short discussion of their habits. The larva and pupa of *O. texanus* were pictured and the biology summarized in a paper by Howden (1957).

The habits of many of the European species of *Onthophagus* have been studied rather intensively, the information on these being summarized in a book by von Lengerken in 1954. In this work the habits of *O. nuchicornis*, now established in Canada and the United States, are described in some detail. The habits of a number of other North American species have received casual mention in numerous papers; these papers are cited in the discussion of habits following the description of each species.

Methods

In the course of this study most of the larger collections of North American *Onthophagus* were examined by one or both of the authors. Almost all the distribution data contained in this paper were taken from specimens personally examined; most place names were taken from pin labels and obvious misspellings have been corrected by the authors. Complete data are given only when less than 20 specimens of a species are known or when all are from one or two localities. In addition to borrowed material, all the type material available in the eastern United States and Canada was studied. Type specimens were borrowed from museums in London, Berlin, and Munich, and specimens were compared with types in Paris, as stated in acknowledgments.

Descriptions of adults are based entirely on external characters. Male genitalia were found useful in some species, but proved more difficult to use than the external characteristics. Separation of closely related forms by characters of the genitalia appeared impossible, and for that reason descriptions of genitalic features have been omitted.

Additional adult material and much of the biological information was procured personally during extensive trips (see Acknowledgments, p. 1).

Adult specimens were collected at dung, carrion, or fungi, and by trapping. Traps were made of tin cans, the 16 to 32-ounce sizes, with the tops cut out, sunk level with the ground surface and partly filled with dung, fungi, or a fermenting bait. One of the more successful baits was a mixture of one pint of malt extract to one gallon of water with a pinch of dried yeast added. An inch of the fermenting mixture was poured in the sunken can and usually 2 to 3 cc. of propionic acid was added to the can. The malt by itself attracted mainly the fungus feeders; the acid was attractive to the dung feeders. The mixture attracted both of these groups in numbers.

Many of the rarer species were found in animal nests or burrows and were seldom, if ever, taken outside of their particular niche. Occasional specimens were taken at light. Some of the more unusual habitat niches in which *Onthophagus* have been found are wood rat nests, gopher tortoise burrows, prairie dog burrows, woodchuck burrows, and caves containing bat dung. Other types of mammal and bird nests were also investigated, but generally proved unproductive.

Larvae of a number of the species were obtained by simply placing adults in 12-inch soil-filled flower pots covered with a piece of glass. Fresh dung was placed on top of the soil in the pot and the beetles left undisturbed for several weeks. In nearly all cases where a number

of adults were placed in a single pot, at least a few brood cells were formed. These cells were removed and placed in 3-ounce metal salve boxes with a small amount of soil. Many of the cells were partly opened, and the larval development observed from day to day. Some of the larvae were preserved, usually by dropping them for 3 minutes in water heated nearly to boiling and then transferring them to 70 percent alcohol. Most of the preserved larvae are now in the collection of the U.S. National Museum.

Although Howden was chiefly responsible for the biological parts of the study and Cartwright for the library research, the study of the specimens and the writing of this review of our *Onthophagus* has been a joint undertaking with each author sharing equally in all of it so far as was possible. Responsibility for any shortcomings or errors in fact or judgement in the following must devolve equally upon both.

Genus *Onthophagus*

Onthophagus Latreille, 1802, p. 141.—Lacordaire, 1856, pp. 107–110.—Horn, 1875, pp. 137–141.—Bates, 1887, pp. 66–82.—Blatchley, 1910, pp. 917–920.—Schaeffer, 1914, pp. 290–300.—Leng, 1920, pp. 248–249.—Boucomont and Gillet, 1927, pp. 118–217.—Boucomont, 1932, pp. 293–332.—Ritcher 1945, pp. 13–23.

Type of genus: *Scarabaeus taurus* Schreber. By monotypy.

Latreille in his original description of the genus *Onthophagus* cited only one species as an example, "*Copris taurus* Oliv." *Copris taurus* of Olivier (1790, p. 168) was first described under the name *Scarabaeus taurus* by Schreber (1759, p. 7), Schreber's description being among some 16 references to the species listed by Olivier. Inasmuch as *Copris taurus* was the only species listed by Latreille, the Curtis (1825) designation of *nuchicornis* Linnaeus as type was invalid and cannot be accepted under the international rules of zoological nomenclature. The type of the genus must be *Scarabaeus taurus* Schreber.

The genus *Onthophagus*, placed in the tribe Onthophagini of the subfamily Coprinae and family Scarabaeidae, is perhaps the largest genus of beetles known. Nearly 1500 species have been described. In 1930, F. Burmeister stated the worldwide total number of species was somewhat over 1400. More than half, 761, were listed from Africa, 332 from Asia, 152 from Oceania, 85 from Europe, and 84 from America. The Blackwelder checklist, published in 1957, enumerated 79 species from Mexico, the West Indies, and Central and South America. The present paper includes 37 known species from the United States and Canada, only 7 of which are also found south of our borders. Inasmuch as 5 of the 7 are new species, the total number for the Western Hemisphere is now 114.

In the present study we have examined *Onthophagus* from every state in the United States except Washington, Oregon, California, and Nevada. A fossil species, however, has been described from California. Pierce (1946) described *Onthophagus everestae* on the basis of a head and front tibia found in the La Brea tar pits.

The original description follows:

> Genre. Onthophage; onthophagus. Dernier article des palpes maxillaires ovalaire. Palpes labiaux terminés par des articles qui paroissent plus grands et qui sont trèhérissés de poils.
>
> Corps presque rond, un peu déprimé. Chaperon demicirculaire, alongé. Corselet très grand, se rapprochant de la figure circulaire, énchancré en devant. Pattes des bousiers.
>
> Exemple. *Copris taurus* Oliv.

ADULTS.—In the United States and Canada the beetles of the genus *Onthophagus* are small to moderate in size, 2.8 to 14.0 mm. in length, oblong oval, with a short thick compact body, convex above and below, with middle legs far apart and hind legs far back. Males usually have the head horned or tuberculate and (or) the pronotum with horns or other protuberances; females have the head carinate and sometimes the pronotum with a carina or other minor elevation.

Mentum hairy, transverse, quadrangular, emarginate; labial palpi hairy, 3-segmented, the first segment slightly shorter than the second, the third very small and inconspicuous, the first segment obovate in profile and abruptly produced on the upper side while the second is securiform and obliquely truncate. Labrum membranous, densely ciliate, concealed by the clypeus. Mandibles elongate, rounded, without teeth, membranous toward apex, and ciliated on internal edge. Maxillae terminating in a large membranous ciliated lobe, palpi 4-segmented, the first segment short and slender, the second and third short and more robust, the fourth fusiform and truncate at the end. Clypeus relatively smooth in the male, carinate in the female, varible in shape. Antennae 9-segmented, with a densely, finely pubescent 3-segmented club. Pronotum large, convex, rounded downward at sides. No visible scutellum. Elytra short, a little convex, somewhat narrowed and rounded posteriorly; seven striae. Legs moderate; the anterior tibiae quadridentate, sometimes slender and elongate in males, with tarsi present in both sexes; middle and posterior tibiae apically enlarged and truncate; tarsi slender, ciliated on inner edge, the first segment elongate and subparallel; claws small. Metasternum long and somewhat parallel-sided, separated from the very short mesosternum by a rectilinear groove. Pygidium exposed. Males with last abdominal segment broadly emarginate at middle; females with last segment not constricted at middle, practically uniform in length.

LARVAE.—The pronounced hump-backed appearance is a conspicuous characteristic of the larvae of *Onthophagus* as in all Coprinae; however, the humped back is accentuated in the larvae of *Onthophagus* by the presence on the third abdominal segment of a dorsal conical protuberance bearing numerous setae. The known larvae are all very similar morphologically, the last abdominal segment exhibiting some of the most useful characters for the separation of the species.

Larval development is similar for all known species. Three instars are present, each stage lasting from 8 days to 2 weeks. Development from egg to teneral adult is rapid, usually taking only 5 or 6 weeks. Emergence of the adults from the pupal cells may be delayed in hot dry weather and during the winter.

Construction of the brood cells is likewise rather typical. The burrows, made at the edge of or under dung, are often twisted, sometimes branched, and vary in depth from 1 to 9 inches, depending on the species. The oval brood cell, approximately 1½ times as long as wide and filled with dung, is formed nearly horizontally at the end of the burrow or branch. After the egg is fastened on end to the side of a small cavity formed in the upper end of the dung, the cavity wall is sealed with the same material. The burrow may then be partly refilled with soil and the egg and subsequent larva left without further attention.

Despite the similarity of the larvae and larval development in in the various species, the study of their habits has been extremely interesting because of the restricted habitat niches of a number of them. A discussion of the preferred food and habitat follows the description of each species.

The species from the United States and Canada have been known under many names. Various authors have used several different names for the same species with resulting confusion and misidentifications. Mistakes made by recognized authorities of an earlier day were frequently followed by subsequent workers. We have attempted to correct all such errors, added names of new species, and compiled the following table in the process.

Name used	*Present status*
aciculatulus Blatchley, 1928, p. 128	Valid.
aciculatus Blatchley, 1928, p. 128	Misspelling of *aciculatulus* Blatchley.
alluvius, new species	Valid.
alutaceus Blatchley, 1919, p. 31 (not Wiedemann, 1823, p. 14)	=*aciculatulus* Blatchley.
ammon Sturm, 1826, p. 177	=*Copris minutus* (Drury).
anthracinus Dejean, 1836, p. 158	Nomen nudum.
anthracinus Harold, 1873, p. 104 (not Falderman, 1835, p. 247)	=*monticolus*, new species and (or) *alluvius*, new species.
arizonensis Schaeffer, 1909, p. 382	=*hōpfneri* Harold.
arnetti, new species	Valid.

Name used	*Present status*
batesi, new species	Valid.
blatchleyi Brown, 1929, p. 86	Subspecies of *hecate* (Panzer).
brevifrons Horn, 1881, p. 76	Valid.
browni, new species	Valid.
canadensis (Fabricius), 1801, p. 34	Subspecies of *orpheus* (Panzer).
carolinus Strum, 1826, p. 177	=*Dichotomius carolinus* (Linnaeus).
castaneus Melsheimer, 1846, p. 134	=*striatulus* (Palisot de Beauvois).
cavernicollis, new species	Valid.
cavicornis Lacordaire, 1856, p. 109	Misspelling of *cervicornis* Kirby.
cervicornis Kirby, 1825, p. 565	Not in U.S. See *striatulus* (Palisot de Beauvois).
cochisus Brown, 1927, p. 132	Valid.
concinnus Dejean, 1836, p. 157	Nomen nudum.
concinnus Laporte, 1840, p. 87	Valid.
coproides Horn, 1881, p. 79	Valid.
cribricollis Dejean, 1836, p. 158	Nomen nudum.
cribricollis Horn, 1881, p. 76	=*subaeneus* (Palisot de Beauvois).
cynomysi Brown, 1927, p. 131	Valid.
depressus Harold, 1871, p. 116	Valid.
falcipes Harold, 1871, p. 115	Attributed to Germar in litt. Nomen nudum.
flavicornis Germar, 1824, p. 105	=*aenescens* Wiedemann ex Java. Not in U.S.
floridanus Blatchley, 1928, p. 128	Subspecies of *striatulus* (Palisot de Beauvois).
furcicollis Dejean, 1836, p. 157	Nomen nudum.
gracilicornis Sturm, 1843, p. 107	=*gracilicornis* Germar ex India. Not in U.S.
granarius Dejean, 1836, p. 158	Nomen nudem.
guatemalensis Bates, 1887, p. 73	Not in U.S. See *medorensis* Brown.
haemorrhous Sturm, 1843, p. 108	Nomen nudem.
hastator (Fabricius), 1798, p. 28	=*hecate* (Panzer).
hecate (Panzer), 1794, p. 5	Valid.
höpfneri Harold, 1869, p. 512	Valid.
incensus Say, 1835, p. 173	Valid (Hawaii but not mainland U.S.).
janus (Panzer), 1794, p. 5 (not Olivier, 1789, p 101)	=*striatulus* (Palisot de Beauvois).
knausi Brown, 1927, p. 130	Valid.
knulli, new species	Valid.
lama Dejean, 1836, p. 157	Nomen nudem.
landolti Harold, 1880, p. 34	Subspecies found in U.S. See *landolti texanus* Schaeffer.
latebrosus Buquet (Dejean, 1836, p. 159)	Nomen nudum.
latebrosus (Fabricius), 1801, p. 134	=*hecate* (Panzer).
lecontei Harold, 1871, p. 115	Not in U.S. See *subopacus* Robinson.
medorensis Brown, 1929, p. 204	Valid.
minutus Sturm, 1843, p. 108	Nomen nudum.
moeris Sturm, 1826, p. 178	Attributed to Melsheimer. Nomen nudum.
monstrosus Dejean, 1836, p. 157	Nomen nudum.
monticolus, new species	Valid.

Name used	*Present status*
niger Melsheimer, 1846, p. 134	=*striatulus* (Palisot de Beauvois).
nigrescens Blatchley, 1916, p. 94 (not d'Orbigny, 1902, p. 21)	=*striatulus floridanus* Blatchley.
nuchicornis (Linnaeus), 1758, p. 547	Valid.
obtectus (Palisot de Beauvois), 1805, p. 25	=*hecate* (Panzer).
obscurus Sturm, 1826, p. 178	Nomen nudum.
oklahomensis Brown, 1927, p. 128	Valid.
orpheus (Panzer), 1794, p. 5	Valid.
ovatus (Linnaeus), 1767, p. 551	Not in U.S. See *pennsylvanicus* Harold.
pennsylvanicus Harold, 1871, p. 115	Valid.
polyphemi Hubbard, 1894, p. 311	Valid.
protensus Melsheimer, 1846, p. 134.	=*concinnus* Laporte.
pseudorpheus, new subspecies	Subspecies of *orpheus*.
rhinoceros Melsheimer, 1846, p. 134	=*nuchicornis* (Linnaeus).
sayi Laporte, 1840, p. 87	=*hecate* (Panzer).
scabricollis Kirby, 1837, p. 126	=*hecate* (Panzer).
schaefferi, new species	Valid.
sparsisetosus, new subspecies	Subspecies of *polyphemi* Hubbard.
striatulus (Palisot de Beauvois), 1809, p. 92	Valid.
subaeneus (Palisot de Beauvois), 1811, p. 105	Valid (*cribricollis* of authors).
subopacus Robinson, 1940, p. 142	Valid.
substriatus Schaeffer, 1914, p. 292	=*striatulus* (Palisot de Beauvois).
subtropicus, new species	Valid.
texanus Schaeffer, 1914, p. 299	Subspecies of *landolti* Harold.
tuberculatus Gemminger and Harold, 1869, p. 1038	Attributed to Zimmerman in litt. Nomen nudum.
tuberculifrons Harold, 1871, p. 115	Valid.
velutinus Horn, 1875, p. 140	Valid.
viridicatus Say, 1837, p. 173	=*Canthon viridis* (Palisot de Beauvois).
viridicollis Sturm	Attributed to Megerle. Nomen nudum.
xiphias LeConte, 1863, p. 36 (footnote)	=*nuchicornis* (Linnaeus).

Species of *Onthophagus* of the United States and Canada may perhaps be most easily separated from other Scarabaeidae by using the following combination of characters: body more or less oval in shape from dorsal view; scutellum not visible; elytra with striae not deeply impressed and the intervals not distinctly convex; last abdominal spiracle hidden by the elytra; front coxae large, elevated, front legs with tarsi; middle coxae widely separated; middle and hind tibiae widened at apex; males with last abdominal segment narrowed

medially to receive the pygidium, last segment not narrowed medially in the female.

Key to the *Onthophagus* of the United States and Canada

1. Disc of pronotum tuberculate or simply punctate; setae not flattened if present 2
   Disc of pronotum closely, setigerously, annularly punctate, the ringlike punctures separated by less than their diameters; each puncture anteriorly with a distinct tubercle, centrally with a short recumbent flattened yellow seta; Georgia, Florida, and South Africa.
   depressus Harold (p. 126)

2(1). Disc of pronotum smooth or distinctly punctate, tubercles lacking on disc or if present, less than one-half of the diameter of nearest puncture in basal area 3
   Disc of pronotum tuberculate; punctures, if present, vague with diameters approximately equal to that of the tubercles 33

3(2). Color uniform, rarely with humeral umbone or entire elytra lighter in teneral specimens 4
   Pronotum and elytra decidedly different in color, or elytra bicolored or spotted 26

4(3). Species over 7.5 mm. in length, except rarely in *batesi* in which the nonsetate, finely punctate shining pronotum will distinguish it from the small western species considered here; species occurring west of the Mississippi River 5
   Species under 7.5 mm. in length or, if over 7.5 mm., occurring east of the Mississippi River 11

5(4). Basal half of pronotal disc smooth and minutely punctate or very much more finely punctate basally than anteriorly, shiny black or brown . . 6
   Pronotum more or less uniformly punctate except near posterior edge . . 8

6(5). Lateral margin of pronotum lacking an abrupt angle between anterior and posterior pronotal angles 7
   Lateral margin of pronotum with an abrupt angle between anterior and posterior pronotal angles; New Mexico, Colorado, Arizona.
   coproides Horn (p. 14)

7(6). Cephalic horns of male united by a sharp carina evenly arcuate down one horn across the front and up the other; female with a low, evenly elevated anterior clypeal carina; Texas to Panama.
   batesi, new species (p. 21)
   Cephalic horns of male not united by a carina across the front; female with anterior clypeal carina noticeably higher at middle; Mexico to Costa Rica, Hawaii . . . . . **incensus** Say (p. 24)

8(5). Punctures of pronotum close and more or less uniform in size, separated by less than their diameters, each with a short black inconspicuous seta; surface dull black, finely alutaceous; Arizona.
   cochisus Brown (p. 18)
   Large punctures of pronotum usually separated by one or more diameters, with or without setae; pronotum alutaceous or smooth and shining 9

9(8). Pronotal punctures, at least laterally, with moderately long setae; elytra shining . . . . . **orpheus** complex; see couplet 17
   Pronotal punctures, at most, with minute setae; elytra dull, distinctly alutaceous 10

10(9). Pronotum largely smooth between punctures; frontal carina of male extending almost to eye; female frontal carina gradually elevated from middle to rounded ends which drop sharply to head surface, the ends nearer to eye than to middle; Kansas to Arizona.

brevifrons Horn (p. 27)

Pronotum finely alutaceous; male frontal carina extending not more than one-half distance from middle to eye; female frontal carina with each side elevated to a sharp tubercle, the tip of each nearer to the middle than to the eye; Texas . . . **subtropicus,** new species (p. 30)

11(4). Disc of pronotum virtually impunctate, shiny black or brownish black; males without horns or protuberances on head or pronotum, 5 to 7 mm. in length; found in burrows of gopher tortoise 12

Disc of pronotum distinctly punctate 13

12(11). Elytral intervals with one or two rows of setigerous punctures, punctures often with a tubercle at anterior margin; east coast of Florida, South Carolina . . . . . **polyphemi polyphemi** Hubbard (p. 35)

Elytral intervals 2 and 4 with only a few scattered setae, nearly impunctate; Florida west of Apalachicola River to Mississippi.

polyphemi sparsisetosus, new subspecies (p. 38)

13(11). Shining, black, brown, blue, green, or cupreous; more than 4 mm. in length; pronotum lacking numerous smaller secondary punctures . . 14

Dull or feebly shining, alutaceous, brown or black, or if shining only 3 to 4 mm. in length; some species with small secondary punctures on pronotum 19

14(13). Pronotum without basal margin; clypeal emargination, if any, not dentate on each side 15

Pronotum narrowly margined basally; clypeus usually more or less bidentate, the teeth low, triangular, and well separated; male with conical pronotal protuberance, without tubercles or horns behind eyes; less than 5.5 mm. in length; shining blackish green or coppery; Atlantic coast to Kansas, Oklahoma, and Texas.

subaeneus (Palisot de Beauvois) (p. 72)

15(14). Second and third elytral intervals with three rows of setigerous tubercles; male with long slender horn above each eye; pronotal protuberance of male rounded not projecting above head 16

Second and third elytral intervals with one or two rows of setigerous punctures or tubercles; male pronotum with bifurcate protuberance projecting above head 17

16(15). Elytral intervals alutaceous between tubercles; Vermont to Florida, west to Nebraska and Texas.

striatulus striatulus (Palisot de Beauvois) (p. 41)

Elytral intervals smooth and shining between tubercles; Florida to South Carolina. . . . . **striatulus floridanus** Blatchley (p. 45)

17(15). Elytral intervals with small tubercles anterior to each indistinct puncture; pronotal punctures usually large and close, often anteriorly tuberculate; body commonly green above, the head and pronotum rarely with slight coppery cast, elytra often blackish 18

Elytral intervals, particularly the fifth, distinctly punctate, the anterior tubercles lacking or barely indicated; pronotal punctures more widely spaced, usually shallow, lacking anterior tubercles; body above shining green to distinctly coppery red; Ontario, northeastern United States, and Appalachian Mountains to South Carolina.

orpheus canadensis (Fabricius) (p. 50)

18(17). Male major lacking a distinct clypeal carina; female with frontal carina evenly elevated or highest at middle; setae of pronotum and elytra not conspicuous; in forested areas of eastern United States.
orpheus orpheus (Panzer) (p. 47)

Male major with a distinct clypeal carina, often elevated medially; females with frontal carina highest near eyes; setae of pronotum and elytra conspicuous; Great Plains from Manitoba to Kansas.
orpheus pseudorpheus, new subspecies (p. 53)

19(13). Pronotal punctures not crowded, separated by at least 1 diameter 20

Punctures of pronotum shallow, dense, and crowded; punctures from nearly contiguous to separated by less than 1 diameter, somewhat annular, mixed setigerous and nonsetigerous; male with conical pronotal protuberance; brownish black; Illinois, Nebraska, east Texas.
knausi Brown (p. 76)

20(19). Anterior edge of pronotal punctures lacking tubercles 22

Anterior edge of pronotal punctures with a small shining tubercle . 21

21(20). Length 4 to 4.5 mm.; feebly shining; punctures separated by 1 diameter; basal carina of head reduced to two tubercles in male; Florida.
aciculatulus Blatchley (p. 79)

Length 4.5 to 6.5 mm.; dull, alutaceous; punctures usually separated by 2 to 3 diameters; pronotal protuberance of male short, moderately broad, flat, slightly emarginate, and depressed at middle; Arizona.
subopacus Robinson (p. 59)

22(20). Pygidial punctures very shallow, at least in basal half, sometimes deep and distinct if apical half of pygidium is shining; male with conical pronotal protuberance; female with protuberance usually feebly indicated 23

Punctures of pygidium deep, only slightly smaller basally; males and females without any indication of pronotal protuberance 25

23(22). Pygidium apically convex, shining, distinctly punctate; nearly impunctate and alutaceous basally; pronotal punctures usually lacking distinct margins, fairly uniform in size; Texas and Arizona . . 24

Pygidium almost flat, very shallowly, indistinctly punctate, alutaceous almost to apex; pronotal punctures with distinct margins, often appearing annular; small shallow nonsetate secondary punctures scattered among large punctures; Big Bend region of Texas and mountains of northeastern Mexico.
monticolus, new species (p. 61)

24(23). Posterior half of metasternum medially impunctate or with one or two shallow punctures; Texas . . . . . **alluvius,** new species (p. 65)

Posterior half of metasternum medially with a few very large punctures near midline; Arizona . . . . . **knulli,** new species (p. 69)

25(22). Dull brownish-black species with pronotal punctures generally the same size, usually all with setae; New Hampshire to Florida and South Dakota to Texas . . . . . **pennsylvanicus** Harold (p. 82)

Shining black species with pronotal punctures of two sizes, very small punctures lacking setae scattered among the large punctures; Virginia to Texas . . . . . **oklahomensis** Brown (p. 80)

26(3). Large species over 7.5 mm. in length, with unicolorus elytra; west of the Mississippi River from Arkansas to Texas 27

Species under 7.5 mm. or having spotted or bicolored elytra 28

27(26). Pronotum shining green, frontal carina of male extending almost to eye; female frontal carina wide, gradually elevated from middle to the rounded ends which drop sharply to surface of head, the ends nearer eye than middle; in bat caves, Arkansas to Texas.

cavernicollis, new species (p. 32)

Pronotum with at most a greenish cast; male frontal carina extending not more than one-half distance from middle to eye; female frontal carina with each side elevated to a sharp tubercle, the tip of each tubercle nearer the middle than to the eye; Texas.

subtropicus, new species (p. 30)

28(26). Head and pronotum dull black, elytra largely brown speckled with black; length 6.7 to 9.5 mm.; male with median horn on vertex behind eyes; female usually with small prontal hump behind head; southern Canada and northern United States except Central Plains area.

nuchicornis (Linnaeus) (p. 123)

Characters not as above 29

29(28). Pronotum shining between punctures, not dull brownish black; pygidium usually distinctly punctate with at least apical half shining . . . 30

Pronotum dull brownish black, alutaceous between setigerous punctures; pygidium shallowly punctate, usually alutaceous at least to apical third; elytra dull black with scattered small round yellowish spots, particularly along apical margin; eastern United States to Kansas and Oklahoma, rarely Texas and Arizona.

tuberculifrons Harold (p. 85)

30(29). Punctures of pronotum lacking tubercles at anterior margins; males without horns on the head 31

Punctures of pronotum with small tubercle in front of each seta; base and apex of elytra brownish yellow; head of male with two slender horns extending upward behind the eyes; Vermont to Florida, west to Nebraska and Texas.

striatulus striatulus (Palisot de Beauvois) (p. 41)

31(30). Pygidium bicolored, rarely all yellow 32

Pygidium uniformly dark; pronotum and elytra shining greenish brown to black; elytra with a reddish-yellow spot just inside each humerus and frequently smaller round discal spots scattered elsewhere but always showing on the fifth interval first; Texas.

schaefferi, new species (p. 88)

32(31). Base of pronotum finely margined only at middle; pronotum black or brownish black, occasionally greenish black; anterior angles of pronotum and frequently lateral and anterior margins yellow; yellow of elytra often forming stripes; apex of elytra frequently yellow but usually broken by a dark marginal spot at end of fourth interval; fifth interval never with discal spots, rarely with base and apex yellow; Texas . . . . . **landolti texanus** Schaeffer (p. 91)

Base of pronotum completely margined; pronotum green or coppery, anterior angles not lighter in color; elytra usually with irregular yellow areas at base and apex and with at least a few small round spots on disc; Arizona . . . . . **höpfneri** Harold (p. 95)

33(2). Tubercles of pronotum very conspicuous. Clypeus of males triangularly produced upward at middle, clypeus of females evenly rounded; if not, elytra bicolored 37

Tubercles of pronotum moderate with moderate to vague punctures at their bases; clypeus of both sexes broadly rounded or slightly emarginate 34

34(33). Surface of pronotum and (or) elytra finely alutaceous. 35
Surface of pronotum and elytra between tubercles smooth and shining; in prairie dog burrows; Oklahoma, New Mexico.
cynomysi Brown (p. 57)

35(34). Uniformly brown or black; eyes flat and narrow, 6 to 7 facets wide; anterior pronotal angles sharply rounded, posterior angles more broadly rounded, 140° to 145°. 36
Pronotum greenish, elytra black; eyes noticeably convex, 10 facets wide; anterior pronotal angles broadly rounded, posterior angles more sharply rounded, 130°. Length 6.6 to 8.6 mm.; southern Arizona. . . . . **arnetti,** new species (p. 98)

36(35). Pronotum of male with flat projecting protuberance, its wide shallow, usually angular emarginate anterior edge wider than base, and its external angles rounded; females with carina of vertex distinctly bent posteriorly at middle; female pronotal protuberance distinct, sharply defined; western Texas to Arizona.
browni, new species (p. 101)
Head of male with two upright diverging slender horns in front of the high angulate anterior margin of pronotum; females with carina of vertex nearly straight; thoracic protuberance of female very weak, poorly defined; Texas, Colorado to Arizona . . **velutinus** Horn (p. 105)

37(33). Pronotum bright shiny green or bluish; elytra usually bicolored, green with yellow base and apex; Pennsylvania to Florida and Louisiana.
concinnus Laporte (p. 108)
Color feebly shining to dull uniform dark green, blue, or black, sometimes with brown spots at apex of elytra 38

38(37). Elytral intervals triserially tuberculate; male without basal cephalic horns 39
Elytral intervals biserially punctate-tuberculate; green, blue, or black; male with short acute basal horn directed upward and outward behind each eye; Kansas to Texas and Louisana.
medorensis Brown (p. 112)

39(38). Pronotal setae fine and long, length much greater than distance between elongate oval tubercles; east of Rockies.
hecate hecate (Panzer) (p. 115)
Pronotal setae short, inconspicuous, scarcely longer than distance between small round tubercles; usually brown spots at apex of elytra; Florida to South Carolina . . . . **hecate blatchleyi** Brown (p. 120)

Onthophagus coproides Horn

PLATE 1, FIGURES 4 AND 5

Onthophagus coproides Horn, 1881, p. 75.—Henshaw, 1885, p. 87.—Schaeffer, 1914, p. 293.—Leng, 1920, p. 248.—Dawson, 1922, p. 178.—Boucomont and Gillet, 1927, p. 205.—Boucomont, 1932, p. 297.

Onthophagus cuboidalis Bates, 1887, p. 79.—Boucomont, 1932, p. 297—Blackwelder, 1944, p. 211.

MALE MAJORS.—Length 11.5 to 14.0 mm., width 7.1 to 7.3 mm. Dorsally and ventrally brown to piceous, with legs same color. Clypeus transverse, somewhat quadrangular; lateral anterior angles sharply bent and sometimes extending beyond the lateral margins of the genae; clypeus gradually reflexed between the anterior angles;

margin slightly thickened and slightly emarginate or truncate medially; clypeal disc closely, shallowly, rugosely punctate, the punctures fine to moderate in size, separated by less than a diameter, many confluent; clypeal carina fine, low, evenly elevated, relatively straight, impunctate. Frons slightly convex medially; shallowly, rugosely punctate but less closely than clypeal disc; delimited laterally from the gena by a definite sutural line. Carina of the vertex very strong, bowed forward slightly, almost straight, lowest medially, elevated at each end into a strong horn near the eyes, the carina and horns shallowly punctate anteriorly; genae not distinctly flared laterally, extending no further than the anterior angles of the clypeus, punctures as on clypeus.

Pronotum completely margined, anterior angles rounded and flattened, lateral margins bent downward sharply just in front of the middle. Pronotum convex and tumid anteriorly, not overhanging the head; the tumosity widely and bluntly shaped like an inverted V, the arms of the V extending posteriorly as well-defined ridges, sharply declivous in front of the ridge and weakly concave from lateral end of the ridge down to the margin opposite the eye; the median line weakly impressed over posterior third. The tumosity with a scattered group of 10 to 15 coarse intermixed punctures high on each side of the anterior face; the surface otherwise from closely, moderately punctate anteriorly (the punctures separated by less than a diameter) to gradually much finer over the posterior part of the disc which is smooth and shining between the punctures. Elytral striae shallowly punctate; intervals slightly convex, generally smooth and shining, with scattered fine punctures; a few setae evident posteriorly, largely in the punctures of the sutural interval.

Pygidium shining, moderately punctate, the punctures each bearing a short yellow seta. Ventrally the thorax coarsely punctate laterally, the punctures becoming smaller and finer medially; metasternum smooth and shining, with median line finely, slightly impressed; laterally the punctures bearing long thin dark reddish setae. Abdomen medially impunctate, the last three segments each bearing a row of small setigerous punctures laterally; last segment lighter in color and narrowed medially to receive the pygidium. Forelegs lengthened, the tibia considerably longer and thinner than in the female, with four teeth, the basal one often obsolete; the margin between the teeth smooth, differing in this respect from the other species which have the margin serrated. Middle and hind femora with a few large coarse punctures apically; scattered fine punctures over the entire ventral surface.

MALE AND FEMALE MINORS.—These show only a vague anterior pronotal carina and are quite similar in every way except in the shape

of the frontal carina. In the male the carina is slightly arcuate forward and evenly elevated, with rounded ends. In the female the frontal carina is sharply angulate anteriorly at the middle, and the ends are also sharply angulate and prominent. The front tibia is slightly wider in the female.

FEMALES.—Length 11 to 11.3 mm., width 6.5 to 7.2 mm. Differing from male majors in the following respects: Clypeus almost evenly arcuate, anteriorly broadly slightly emarginate and only slightly reflexed; laterally not extending beyond the genae; disc flat and not concave as in male major, surface moderately rugosely punctate; a low clypeal carina separating the clypeus from the frons and extending laterally to the juncture with the genae. Frons moderately coarsely, almost rugosely punctate as are the genae; carina of the vertex strongly developed and strongly angularly bowed forward medially, ending on each side in a long horn as described for the male major.

Pronotum with outline, punctation, convexity, and tumosity similar to the male major. The elytra are similar also. The pygidium is slightly convex apically, shining, and with scattered close setigerous punctures. Ventrally the major differences from male majors are the more pronounced thoracic punctures, the even length of the last abdominal segment, and the shorter, thicker foretibia. The four teeth on the foretibial margin are broader than in the male, but the margin is still smooth and nonserrated. Females show more variation than is usually found in this sex, the horns at the ends of the frontal carina in fully developed individuals being longer than in most males and the high connecting carina being angularly bent far forward with a short but noticeable longitudinal carina extending back from the angle.

TYPE.—Lectotype, present designation, a large female in Academy of Natural Sciences of Philadelphia, Type 3569. Horn stated that the three specimens before him were males, but examination shows all are females.

TYPE LOCALITY.—Santa Fe Canyon, New Mexico (700 ft.).

SPECIMENS EXAMINED.—43.

DISTRIBUTION.—(See fig. 1, p 17.)

NEW MEXICO: Santa Fe Canyon, Water Canyon (5000 ft.), Cloudcroft, Fort Wingate, Las Vegas, El Porvenir (San Miguel Co.), Torrance, 6 mi. south of Thoreau (McKinley Co.) from stomach of *Ambystoma tigrinum*. ARIZONA: Chiricahua Mts., Douglas, Prescott, 8 mi. south of Showlow, Springerville (Apache Co.), General Springs (Coconino Co.), Woolaroc. COLORADO: Colorado Springs. NEBRASKA: Halsey.

REMARKS.—*Onthophagus coproides*, the largest North American *Onthophagus*, can be distinguished by the nonserrated margin between

the tibial teeth of the foretibia, by the high carina of the vertex which ends over each eye in a long horn in both sexes, by the smooth, finely punctate basal portion of the pronotum, by the minute punctures of the elytral intervals, and by the dark brown to piceous overall color.

Though *coproides* appears to be widely distributed in the higher mountains of Arizona, New Mexico, and Colorado, it has also been taken in Nebraska at a lower elevation. The scarcity of specimens in collections indicates a restricted habitat. Quite likely

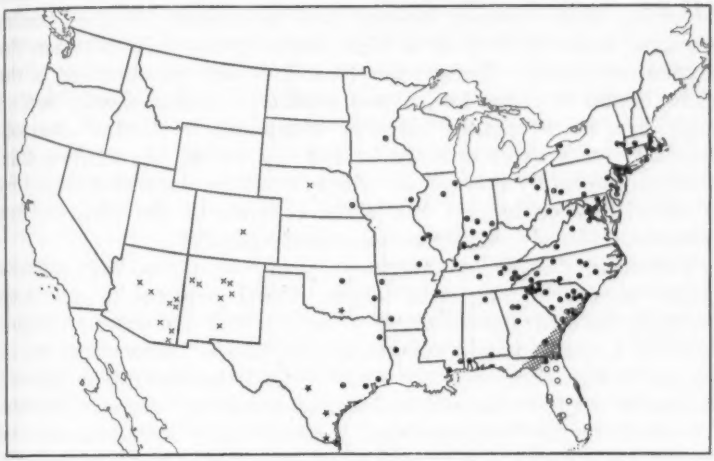

FIGURE 1. Distribution of species of *Onthophagus:*

× *coproides* Horn
● *striatulus striatulus* (Palisot de Beauvois)
○ *striatulus floridanus* Blatchley
★ *landolti texanus* Schaeffer

the species occurs in some rodent nest or animal burrow. It is one of the few species about which little or nothing is known.

Among closely allied Mexican species, a female cotype of *O. hippopotamus* Harold loaned by the British Museum differs in having (1) much denser pronotal punctation which is only very slightly finer even in the basal areas, (2) the pronotal protuberance rounded, not angulate in front as in *coproides*, and (3) the frontal carina on the head straight and evenly elevated its entire length, not angulate forward medially and not elevated into horns at the ends.

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Onthophagus cochisus Brown

PLATE 2, FIGURES 9 AND 10

Onthophagus cochisus Brown, 1927, p. 132.—Boucomont, 1932, p. 317—Leng and Mutchler, 1933, p. 38.

MALE MAJORS.—Length 8.5 to 9.8 mm., width 5.3 to 6.2 mm., color black. Head with clypeus reflexed anteriorly, the disc appearing slightly concave; margin anteriorly broadly arcuate, laterally sharply angulate with sides almost parallel; disc coarsely punctate, punctures becoming more crowded laterally and posteriorly; clypeal carina obsolete, indicated only by a slight convexity medially between the clypeus and frons. Frons coarsely and densely punctate as is the gena; carina of vertex low, bowed anteriorly, ending shortly behind each eye in a slightly elevated sharp ridge. Vertex coarsely punctate for a short distance behind the carina, the surface then becoming smoothly alutaceous. Genae with lateral margins extending a short distance beyond the lateral margins of the clypeus, but with the sides only slightly arcuate, nearly parallel.

Pronotum completely margined, poorly so posteriorly; anterior angles almost forming right angles; lateral pronotal margin bent abruptly upward approximately 1 mm. behind the anterior angles, forming a sharp, nearly tuberculate angulation. Pronotum widest at the middle, approximately 1 mm. behind the angulation, convex, similar in shape to the related Mexican species *O. chevrolati* Harold; the anterior tumosity rising almost perpendicularly behind the anterior margin, with face of the tumosity broadly rounded and laterally concavely arcuate to the small lateral tubercles. Surface of the pronotum smoothly, shallowly concave between the tumosity, tubercles, marginal angulations, and anterior angles; discal surface of pronotum coarsely, densely punctate; anteriorly the surface of the tumosity shining, with the punctures large and often bearing short setae; posteriorly the surface between the punctures dull and alutaceous, with the punctures smaller and bearing short but distinct setae. Elytral striae punctate, scarcely impressed; intervals, except for sutural interval, with from three to five irregular rows of small shiny tubercles, each with a short black seta at its base; surface alutaceous between the tubercles.

Pygidium alutaceous except for smooth apex, the entire surface with scattered shallow punctures, each with a short seta. Ventral surfaces of thorax shining, laterally coarsely punctuate, most of the punctures bearing long fine reddish setae; metasternum finely punctate along the shallowly impressed median line; abdominal segments finely alutaceous, laterally sparsely punctate; last segment piceous in color, narrowed medially, emarginate to receive the pygidium. Fore-

legs moderately elongate; foretibia slender and bent in the apical third, tibial margin serrate above and between the four teeth. Femora with ventral surface having a mixture of scattered large and minute punctures, the coarse punctures usually bearing long setae.

MALE MINORS.—Length 6.1 to 7. mm., width 3.4 to 4 mm. Differing from the male majors in the following characteristics: Clypeus rounded, not flared laterally, reflexed and slightly truncate anteriorly; disc flat, coarsely, evenly, rugosely punctate, posterior clypeal carina obsolete; frons coarsely punctate to shallowly, moderately punctate, laterally and posteriorly alutaceous; carina of vertex evenly bowed, highest medially, the sharp lateral portions of the carina near the eyes greatly reduced; gena with sides broadly rounded, extending slightly beyond the margins of the clypeus. Pronotum evenly convex, coarsely punctate, less so near the anterior angles; surface alutaceous between the punctures, an occasional small anterior smooth area being the only indication of the median tumosity of the male major; lateral pronotal margin only slightly bent in anterior third, not at all angulate. Elytra not significantly different. Pygidium of male minor quite convex, but otherwise similar to male major. Ventral surface similar except for the foretibia, which is slightly bent in the apical half and is shortened and thickened, but to a lesser degree than in the female.

FEMALES.—Length 8.5 to 9.5 mm., width 4.8 to 5.1 mm. Differing from the male majors in the following respects: Clypeus longer and narrower, anteriorly reflexed, truncate or slightly emarginate, sides laterally obliquely arcuate; disc flat, rugosely punctate, posteriorly delimited by a low arcuate carina which is highest medially; frons very coarsely, almost rugosely punctate; carina of vertex pronounced medially, obsolete near the eyes, in some specimens thickened or indented at the median line; vertex behind the carina with scattered coarse punctures, surface finely alutaceous. Pronotum similar to that of male minor; the median tumosity slightly more pronounced, as is the angulation in the anterior third of the pronotal margin. Elytra similar except that the tubercles on the intervals are more pronounced. Pygidium similar. Ventral surface showing the major difference in the foretibia, which is straight, short, and thickened in width, and in the last abdominal segment, which is not emarginate medially.

TYPE.—Academy of Natural Sciences of Philadelphia.

TYPE LOCALITY.—Pinery Canyon, Chiricahua Mts., Cochise Co., Arizona.

SPECIMENS EXAMINED.—346.

DISTRIBUTION.—(See fig. 2, p. 20.)

UNITED STATES: ARIZONA: Pinery Canyon (7000 ft.), Onion Saddle (7000 ft.), Rustler Park (8400 ft.), Southwestern Research Station (5 mi. west of Portal), and Cave Creek Canyon (5400 ft.), all in the Chiricahua Mts.

MEXICO: CHIHUAHUA: Guerrero.

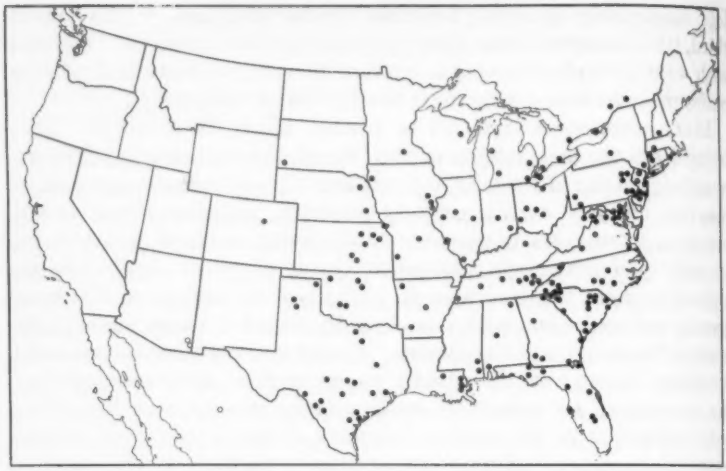

FIGURE 2. Distribution of species of *Onthophagus:*

● *pennsylvanicus* Harold ○ *cochisus* Brown

REMARKS.—In the United States this uncommon species appears to be restricted to the higher elevations (5000 to 8000 ft.) of the Chiricahua Mountains of southeastern Arizona. It seems to be a fairly general feeder as an adult, being taken on carrion and under fresh horse droppings. Howden took 64 specimens on July 3 under leaf litter at Onion Saddle in the Chiricahua Mountains. The specimens were kept alive and attempts were made to rear the specimens in flower pots. Both horse and cow dung were supplied, but owing to higher laboratory temperatures or other unknown factors, no larval cells were formed.

O. cochisus Brown can be separated from other American species north of Mexico by its large size, its dull black alutaceous dorsal surface, and the combination of a densely coarsely punctate pronotum coupled with the conspicuously tuberculate elytral intervals.

Type material of closely allied species from south of our borders was examined and the following differences noted:

O. hippopotamus Harold is slightly larger, is shining, and has punctate rather than tuberculate elytral intervals.

O. totonicapanus Bates is much smoother, with shallow pronotal punctures and practically no elytral tubercles, those showing being scarcely visible and very widely scattered.

O. chevrolati Harold also is smoother in appearance, with pronotal punctures finer, not as close nor as deep, and elytral tubercles much finer and less conspicuous.

O. retusus Harold is also much less closely and evenly punctate, with punctures smaller and with elytral tubercles and striae finer.

O. cyanellus Bates has pronotal punctures very noticeably of two sizes, not uniform as in *cochisus*, and with very much finer tubercles; it is deep blue rather than black.

Onthophagus batesi, new species

PLATE 2, FIGURES 6 AND 7

Onthophagus incensus (Say), Howden, 1955, p. 264.

HOLOTYPE.—Male major, length 8 mm., width 5 mm. Shining, black, with legs and marginal areas of head and pronotum reddish brown. Anterior margin of clypeus abruptly, strongly reflexed; the apex moderately, widely emarginate-truncate; lateral margins not reflexed. Head wider than long, flat, without clypeal carina; genae weak, widely rounded; the eyes convex, 11 facets wide, two-fifths as wide as long; vertex with two long, widely separated, very slightly diverging vertical horns; the horns nearly straight, weakly flattened transversely, with a very distinct U-shaped carina extending down one horn, across the front, and up the other; punctures of head fine, quite evenly distributed in front of carina, separated generally by 2 to 3 diameters, smooth behind carina except at extreme occiput.

Pronotum finely, completely margined; anterior angles moderately, sharply rounded but not acute, posterior angles broadly rounded; median protuberance high, slightly bulbous, nearly vertical, gradually rounding into the relatively shallow, vertical cavity on each side which receives the cephalic horn; surface very finely punctate laterally and medianly over protuberance; lateral cavities, disc, and basal areas very minutely punctate, almost impunctate. Elytra shining; striae fine; strial punctures scarcely crenating the intervals which are almost flat, all very finely, quite closely and confusedly punctate, the punctures separated by 3 to 4 diameters. Pygidium nearly flat, alutaceous except at apex; moderately, coarsely punctate each side of a slightly elevated impunctate median line; the punctures separated by 1 to 2 diameters, those in the basal angles and adjacent lateral areas bearing setae about as long as distance between punctures; setae decumbent and pointing inward and downward toward apex; marginal bead extending upward at apex to a short toothlike process (not evident in other specimens). Legs reddish brown, anterior tibia ending in a blunt, slightly up-turned tooth above the apical spur. Club of antennae fuscorufous.

MALE MINORS.—Length 6 to 9.5 mm., width 4 to 5 mm. Male minors tend to resemble the female in elevation of clypeal apex, length of cephalic horns, pronotal protuberance, and lateral cavities;

many almost duplicate the female except for a trace of a tubercle at each end of the frontal carina, an apical tooth on anterior tibia, and a narrowed middle of the terminal segment of the abdomen.

ALLOTYPE.—Female, length 7 mm., width 4 mm. The clypeus differs from that of the male as follows: Relatively longer; the anterior margin slightly truncate and only very weakly reflexed; the clypeal carina evenly elevated throughout, not higher at middle; the frontal carina evenly elevated, straight except for ends slightly arcuate posteriorly; surface of the clypeus transversely rugose-punctate; the punctures between the rugae moderately coarse, separated by 1 diameter or less, and except for the very fine punctures of the more gentle posterior slope of the clypeal carina and the area back of the frontal carina, the remaining surface similarly closely, moderately coarsely, and deeply punctate. The pronotum with a similar but very weak median protuberance and traces of the lateral cavities; the punctation in the anterior angles generally more noticeable, being about as on the head, gradually finer medially across the anterior, and gradually much finer and sparser over the disc to the base where the fine punctures are generally separated by 4 to 5 diameters. Other characters very similar to male except that the pygidium is more widely shining apically, the anterior tibia lacks the apical tooth, and the terminal abdominal segment is not narrowed medially.

TYPE.—USNM 65681.

TYPE LOCALITY.—La Union, El Salvador.

SPECIMENS EXAMINED.—161.

DISTRIBUTION.—(See fig. 3, p. 24.)

UNITED STATES: TEXAS: 3 ♂♂, 2 ♀♀, Brownsville, June 1, 1954, H. F. Howden (Howden, USNM); 1 ♀, Brownsville, June 21, 1955, Allen (USNM).

MEXICO: 1 ♂, 1 ♀, no locality data, (USNM). CHIAPAS: 1 ♂, Cerro Huaco, Sept. 19, 1949, G. Halffter (CNC); 1 ♀, Chiapas, Pacific slope Cordilleras (800–1000), L. Hotzon (USNM); 2 ♂♂, 1 ♀, Tuxtla, Dr. Berendt (USNM). MORELOS: 1 ♂, Cuernavaca, July 1955, N. L. H. Krauss (USNM); 1 ♂, 3 ♀♀, Cuernavaca, August 1955, cow dung, N. L. H. Krauss (USNM); 1 ♂, 1 ♀, Cuernavaca, June 10, 1957 (USNM); 1 ♂, Cuatla, July 20, 1956, A. W. Vasquez (USNM). JALISCO: 1 ♂, L. Chapala, July 1940, L. W. Saylor (CNC). SAN LUIS POTOSÍ: 1 ♂, El Salto, Aug. 3, 1949, L. J. Bottimer (LJB); 5 ♂♂, 2 ♀♀, El Salto de Agua, Aug. 13–14, 1958, H. F. Howden (CNC); 2 ♀♀, Tamazunchale, Aug. 15, 20, 1956, A. W. Vasquez (USNM). YUCATÁN: 1 ♂, 3 ♀♀, Temax, Gaumer (USNM). JALISCO: 1 ♀, Guadalajara, Aug. 22, 1903 (USNM); 2 ♀♀, Chapala, Aug. 13–16, 1949, L. J. Bottimer (LJB). VERACRUZ: 1 ♀, Veracruz, Apr. 1, 1955, J. Camelo (USNM); 1 ♂, 2 ♀♀, Orizaba (Veracruz?), H. T. Osborn (USNM); 1 ♂, Orizaba (Veracruz?), Salle coll. (USNM); 7 ♂♂, 12 ♀♀, Lake Catemaco, Aug. 8–16, 1960, H. F. Howden (CNC); 1 ♂, 1 ♀, Cotaxtla, July 6, 1957, W. W. Gibson (USNM); 2 ♂♂, 1 ♀, Cotaxtla, Oct. 25, 1957, W. W. Gibson (USNM); 1 ♂, Cotaxtla, Sept. 11, 1957, Campo Exp., W. W. Gibson (CNC); 1 ♂, Cotaxtla, Nov. 11, 1957, W. W. Gibson (USNM). OAXACA: 1 ♂, Oaxaco, Hoege (USNM); 1 ♂, 2 ♀♀, Tuxtepec, J. Camelo G. (USNM); 2 ♀♀, Tuxtepec, J. Camelo G., 1934 (USNM); 2 ♂♂, 2 ♀♀,

Tuxtepec, J. Camelo G., November 1932 (USNM); 1 ♀, Tuxtepec, J. Camelo G., Nov. 7, 1934 (USNM). GUERRERO: 2 ♀♀, 3 mi. north of Mexcala, Aug. 23–24, 1958, H. Howden (CNC). COLIMA: 2 ♀♀, Colima, L. Conradt (USNM); 1 ♀, Volcán de Colima, L. Conradt (USNM).

CANAL ZONE: 1 ♂, Corozal, June 20, 1937, R. Bliss (USNM); 1 ♂, Gamboa, E. E. Frick (CNC); 1 ♂, without locality, June 1944, K. E. Frick (CNC); 1 ♀, Barro Colorado Id., P. Rau (USNM); 1 ♀, Tabernilla, July 1907, August Busck (USNM).

GUATEMALA: 2 ♀♀, no locality, (USNM); 1 ♀, south of Geronimo, Champion (USNM); 1 ♂, Palín, May 1924, W. M. Mann (USNM); 1 ♀, Lake Thiel, 1925, S. Sebastian Retalnuleu (USNM).

HONDURAS: 1 ♂, San Pedro Sula, W. M. Mann (USNM); 1 ♂, Carmelina, W. M. Mann (USNM); 1 ♀, La Ceiba, W. M. Mann (USNM); 1 ♀, San Juan Pueblo, W. M. Mann (USNM).

EL SALVADOR: 2 ♂♂, 2 ♀♀, San Salvador, May 11–15, 1958, O. L. Cartwright (USNM); 1 ♂, 2 ♀♀, San Salvador, June 24, 1958, O. L. Cartwright (USNM); 2 ♀♀, San Salvador, June 9, 1958, O. L. Cartwright (USNM); 2 ♀♀, San Salvador, June 17, 1958, O. L. Cartwright (USNM); 1 ♀, San Salvador, June 7, 1958, O. L. Cartwright (USNM); 2 ♂♂, 2 ♀♀, San Salvador, June 1–5, 1958, O. L. Cartwright (USNM); 1 ♂, San Salvador, June 20–23, 1958, O. L. Cartwright (USNM); 1 ♀, San Salvador, June 21, 1958, O. L. Cartwright (USNM); 6 ♀♀, San Salvador, May 1, 1957, P. A. Berry (USNM); 1 ♂, 1 ♀, San Salvador, June 21, 1958, L. J. Bottimer (LJB); 1 ♂, San Salvador, June 10, 1958, L. J. Bottimer (LJB); 1 ♂, San Salvador, June 15, 1958, L. J. Bottimer (LJB); 2 ♂♂, 2 ♀♀ (includes holotype and allotype), La Union, May 30, 1958, O. L. Cartwright (USNM); 1 ♂, La Union, May 30, 1958, L. J. Bottimer (LJB); 1 ♀, La Palma, June 24, 1958, O. L. Cartwright (USNM); 1 ♂, Tonocatepeque, June 20, 1958, L. J. Bottimer (LJB); 1 ♂, 1 ♀, Volcán Conchagua, June 27–29, 1958, L. J. Bottimer (LJB); 1 ♀, Santa Tecla, Apr. 29, 1954, P. A. Berry (USNM); 1 ♂, La Ceiba, Vera Wellborn (USNM); 1 ♂, no locality; 1 ♂, 1 ♀, Lake Olomega, Dept. San Miguel, July 14, 1925, R. A. Stirton (CNC, Howden); 2 ♀♀, Mt. Cacaguatique, Dept. San Miguel, Dec. 22, 1925, R. A. Stirton (CNC, Howden); 1 ♀, Sonsonate, Aug. 26, Fredk. Knab (USNM).

NICARAGUA: 1 ♂, Managua (8 mi. north), July 28, 1958, S. E. Neff and E. G. Matthews (USNM).

COSTA RICA: 2 ♂♂, 5 ♀♀, Hamburg farm, Reventazón above Limón, Aug. 1, 1928, F. Nevermann (USNM); 1 ♀, Hamburg farm, Reventazón, May 23, 1935, F. Nevermann (USNM); 1 ♀, Hamburg farm, Reventazón, July 28, 1926, F. Nevermann (USNM); 1 ♂, Esparta, Sept. 18, 1905, Fredk. Knab (USNM); 1 ♂, no data (USNM).

REMARKS.—*O. batesi* is normally black, occasionally with faint greenish lustre, and with legs reddish brown. Quite often traces of reddish brown are found narrowly along the base and sides of the pronotum and head. Reddish-brown (teneral?) specimens are also found. The coppery reflections seen in the type and other specimens of *O. incensus* have not been observed in *batesi*. The antennal club is a lighter, redder brown in *batesi*, more fuscous in *incensus*.

This species is more finely punctate than is *incensus* Say, the male horns are united by a rather sharp continuous carina down one horn, arcuate across the front, and up the other, the female clypeal carina is evenly elevated and not higher in the middle as in *incensus*, the

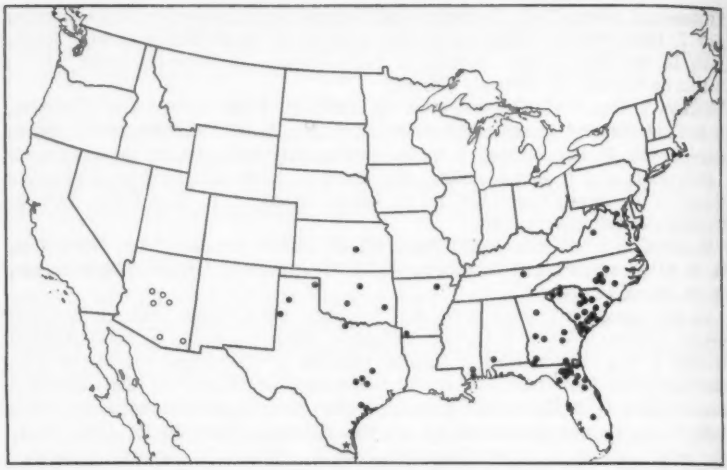

FIGURE 3. Distribution of species of *Onthophagus:*

★ *batesi*, new species
● *oklahomensis* Brown
○ *subopacus* Robinson

frontal carina sometimes breaks downward suddenly, rather angularly at the ends, the eyes are slightly shorter and wider, and in *batesi* the pygidium usually shows a more or less impunctate, slightly elevated median line. If the specimen is turned in reflected light, the even curvature of the pygidium is seen to be slightly broken dorsoventrally by the midline. Many of the male minors show traces of the clypeal carina.

The Brownsville, Tex., specimens were collected in shallow burrows under fresh horse droppings in the area known as the "palm jungle" on the McCormick ranch 7 miles east-southeast of the city.

Onthophagus incensus Say

PLATE 1, FIGURES 1–3

Onthophagus incensus Say, 1835, p. 173.—Lacordaire, 1856, p. 109.—Harold, 1880, p. 30.—Bates, 1887, p. 66.—Boucomont and Gillet, 1927, p. 206.—Boucomont, 1932, p. 308.
Onthophagus curvicornis Latreille var. *incensus* (Say), Boucomont, 1932, p. 308.

MALE MAJORS.—Length 7 to 10 mm., width 4 to 6 mm. Black, shining, sometimes with greenish or coppery lustre at base of head and anteriorly on the pronotum. Anterior margin of clypeus rather widely, shallowly emarginate and sharply reflexed; lateral margins only feebly or not at all reflexed. Head without carinae, slightly wider than long, the genae prominent but obtusely rounded; disc

very slightly convex, basally with two long, widely separated vertical horns slightly curved forward and weakly bowed laterally, the horns somewhat flattened transversely with rounded edges, not connected by a basal carina; punctures of head very fine medially, separated by two or more diameters, somewhat larger laterally, particularly on the genae.

Pronotum finely, completely margined; anterior angles sharply rounded but not acute, posterior angles broadly rounded; median protuberance vertical in front, quite high, the broad rounded summit with a very weak longitudinal, median depression, laterally rounded into a strong vertical cavity each side to receive the cephalic horns. Punctures fine in anterior angles and median groove of protuberance, about as on genae, gradually finer away from these areas to the disc and base; the disc sometimes almost impunctate, lateral foveae strong. Elytra shining, rarely very finely alutaceous; striae fine, the punctures slightly crenating the intervals; intervals weakly convex, all finely, quite closely, confusedly punctate, the scattered punctures separated by 1 to 2 diameters. Pygidium weakly, evenly convex, very finely alutaceous, and not as shining as upper surfaces; punctures close, very slightly larger and deeper than on elytra, occasionally with a few in rows between transverse wrinkles. Legs dark, almost black, the anterior tibia with a blunt, slightly upturned tooth at the tip above the spur; club of antennae fuscous.

Male minors.—Variation is toward the female in reduction in the length of the cephalic horns, the pronotal prominence, and the accompanying lateral cavities. The only noticeable difference between the least developed male seen and a female was the complete absence of the clypeal carina, the presence of the anterior tibial tooth, and the narrowed apex of the terminal abdominal segment.

Females.—Length 7.5 to 10 mm., width 4.75 to 6 mm. Differing from males as follows: Punctation usually more noticeable, closer, and deeper on the upper surface; no tooth or tubercle above the spur of the anterior tibia; the terminal abdominal segment not narrowed apically; clypeus longer, rounded, and not noticeably emarginate-truncate or reflexed; clypeal carina well developed and noticeably higher at middle; frontal carina also well developed but usually slightly lower and posteriorly angulate at middle; anterior prominence of pronotum weak, similar to that of male, but widely depressed medially and laterally reduced to rounded tubercles.

Type.—Museum of Comparative Zoology, Harvard College, Cambridge, Mass.

Type locality.—"Mexico." Barber (1928) stated, "It is probable that all of his (Say's) Mexican forms were collected along the old road between Veracruz, Jalapa, Mexico City, and Tacuba."

SPECIMENS EXAMINED.—196.

DISTRIBUTION.—

UNITED STATES: HAWAII: Oahu: Pohakea Pass, Schofield Plateau; Hawaii: Kona, Kealakekua.

MEXICO: MÉXICO, D.F. HIDALGO: Jacala. VERACRUZ: Jalapa, Córdoba, Orizaba, south of Veracruz, Banderilla.

GUATEMALA: Senahú (Alta Verapaz), Capetillo.

EL SALVADOR: Monte Cristo.

COSTA RICA: Meseta (central Costa Rica), Aurora Farm (Estrella Valley), La Carpintera, Coronado, San José, Coliblanco, Tablaco, Zarzero, Turrialba, Volcán Irazú.

PANAMA: Volcán Chiriquí, Boquete (Chiriquí Province), Bambito (Chiriquí Province), Bugaba.

BIOLOGY.—Taken in numbers in sparse woods near Jacala, Mexico, in cow and horse dung. Burrows in clay soil were 4 to 8 inches deep.

REMARKS.—Say's description of *O. incensus* was published posthumously in the Boston Journal of Natural History for May 1835. The holotype female (pl. 1) is in the Museum of Comparative Zoology at Harvard; it is in fair condition but lacks mouth parts, pygidium, and part of the legs. The pronotum of the type specimen is a very dark green, with reddish-brown lateral spots below the fovea and with narrowly reddish-brown anterior margin opposite the head area between the eyes; the carinae of the head and the pronotal prominence are faintly but distinctly coppery; the elytra are dark blue-black. The narrow brownish anterior margin of the pronotum is found in other Mexican specimens also. The clypeal carina is noticeably higher at middle.

The cephalic horns in fully developed males are only rarely completely connected basally and then by a low swelling or obtuse carina, straight across from one to the other. In *batesi* the connecting carina is nearly always present even in the male minors, curves arcuately from one horn to the other, and is sharply ridged on top.

This species which is very closely related to *batesi*, new species, has not been taken in mainland United States but has been introduced into Hawaii. It was introduced in 1923 by H. T. Osborn from material collected at Morelos, Mexico, to assist in control of the horn-fly, *Siphona iritans* (Linnaeus), and was recovered on the island of Hawaii in 1934 and on Oahu in 1940 (see Swezey, 1935; 1940).

Some females of *curvicornis* Latreille from Colombia are superficially almost identical with *incensus* Say; however, *curvicornis* is usually larger and the fully developed male pronotal protuberance extends forward in a sharply pointed but somewhat flattened cone. Females of *O. acuminatus* Harold also resemble those of *incensus* and *batesi* but are much smaller. The male clypeus in *acuminatus* anteriorly is pointed. *O. nitidor* Bates is slightly smaller and is a

brighter, shining green, with black clypeus; pronotal protuberance in both sexes not as wide.

Onthophagus brevifrons Horn

PLATE 2, FIGURES 12 AND 13

Onthophagus brevifrons Horn, 1881, p. 76.—Henshaw, 1885, p. 87.—Shaeffer, 1914, p. 300.—Leng, 1920, p. 49.—Boucomont and Gillet, 1927, p. 204.—Boucomont, 1932, p. 315.—Howden, Cartwright, and Halffter, 1956, p. 6.

MALE MAJORS.—Length 8.6 to 10.3 mm., width 5.3 to 5.7 mm. Color uniformly brown, piceous, or black; head and pronotum shining, occasionally with violaceous luster, elytral intervals dull, finely alutaceous. Head with clypeus reflexed, more so anteriorly than laterally, anterior edge vaguely emarginate (Horn's Kansas specimens) or truncate, rounded in worn specimens; lateral margin delimited from gena by faint notch, gena scarcely flared, broadly arcuate; disc of clypeus and genae with scattered large shallow punctures, clypeus often rugosely punctate laterally, base of clypeus and anterior portion of frons tumid, the clypeal carina barely indicated by an impunctate line across the tumosity. Frons coarsely punctate, the punctures half the size of the larger clypeal punctures. Surface of clypeus, genae, and frons between the punctures smooth and shining. Carina of vertex low, bowed anteriorly on each side of a raised median point, and ending laterally near the posterior margin of the eyes; scattered coarse punctures behind the carina, smooth areas between the punctures very finely alutaceous.

Pronotum margined anteriorly and laterally, lateral margins noticeably bent downward in anterior third; pronotum convex, with a large, rounded, anterior tu osity rising abruptly behind the anterior margins and ending on each side in a small raised ridge. Below the ridge on each side of the tumosity a shallowly concave area extending to the bend in the lateral pronotal margins and forward to the anterior angles; surface of the concavity finely alutaceous near the anterior angles, otherwise the surface smooth and shining between the pronotal punctures. Punctures of two sizes, large, deep, sharply delimited circular punctures separated by 1 to 2 diameters, and, between these, scattered small well-defined punctures less than one-fourth the diameter of the larger ones; both types of punctures most numerous on the face and along the top of the tumosity, becoming more widely separated posteriorly and near the anterior angles; large punctures on the face of the tumosity often bearing setae.

Elytral striae coarsely punctate, shallowly impressed; intervals with numerous small shining tubercles with fine setae at their bases, the surface between the tubercles finely alutaceous, tubercles on the third,

fourth, and fifth intervals forming two irregular rows. Pygidium convex near apex, surface finely alutaceous with scattered poorly defined punctures usually bearing minute setae. Underside of thorax with coarse punctures laterally, the punctures bearing moderately long reddish setae; impunctate or with very fine punctures medially. Abdominal segments bearing scattered punctures laterally, last segment moderately emarginate medially. Foreleg scarcely longer than in female, not slender or bent in anterior third; four teeth of the tibia broad and stubby; tibial margin only serrate or finely denticulate above the last tooth, not serrate on or between the teeth. Ventral surfaces of femora with a few widely scattered coarse punctures and with more numerous but still scattered, fine punctures.

MALE MINORS.—Length 7.2 to 8.4 mm., width 4.1 to 4.7 mm. Similar to females in clypeal outline and pronotal configuration. Clypeal carina present but not as pronounced as in females; frontal carina low, nearly straight, highest in middle instead of at ends as in females. Similar to male majors in other respects.

FEMALES.—Length 7.1 to 9.6 mm., width 4.0 to 5.2 mm. Differing from the male majors in the following respects: Head with broadly arcuate clypeus, shallowly reflexed anteriorly and laterally, anterior margin slightly emarginate; disc flat, transversely rugosely punctate; clypeal carina broadly raised, highest medially, laterally becoming merely a raised line between the clypeus and genae. Frons and genae coarsely, irregularly punctate, some of the punctures bearing fine reddish setae. Carina of vertex distinct, lowest at the midpoint, rising evenly (in the majority of specimens) to the point where the carina terminates near the base of each eye; in a few of the diminutive females the carina straight across, not raised laterally, but in the larger specimens the carina distinctly elevated near each eye, horns not present, the elevated portions being merely the ends of a very obtuse V-shaped carina. Behind the carina the vertex bears some scattered coarse punctures, with impunctate areas finely alutaceous.

Pronotum moderately convex, broadly tumid in the large females, only slightly so in small specimens; tumosity, when developed, approximately as wide as head with only faint concave areas on each side; lateral margins of the pronotum only vaguely bent in anterior third; surface of pronotum bearing large and small punctures similar to male major, many of the large punctures of the disc bearing short inconspicuous setae. Elytra and pygidium similar to those of male major. Ventral surface generally with more pronounced punctures than in male. Last abdominal segment not narrowed medially. Foretibia slightly shorter and wider than in male major but not greatly different, outer margin serrate or denticulate only above the four tibial teeth and not between them.

TYPE.—Lectotype, present designation, a male in Academy of Natural Sciences of Philadelphia, Type 3570.

TYPE LOCALITY.—"Plains of Kansas."

SPECIMENS EXAMINED.—101 and fragments.

DISTRIBUTION.—(See fig. 4.)

KANSAS: "Plains of Kansas." ARIZONA: Paradise, base of Pinal Mts., Globe, Prescott, Yavapai Co., Portal. TEXAS: (Cited without locality by Horn, 1881, p. 76).

REMARKS.—This species can be distinguished by its large size, black or brown color, and shining, usually tumid pronotum. The head may occasionally have greenish or violaceous reflections, but the pronotum is never distinctly green, as stated by Horn (1881, p. 76). Pronotal disc with numerous, sharply delimited circular coarse and fine punctures. Elytral intervals tuberculate, flat areas finely alutaceous, not smooth and shining. Foretibia not greatly differing between the sexes; tibial margin of both with four broad teeth, the margin serrate basally, but smooth between the teeth. This species may be distinguished from the following species, *subtropicus*, new species, by the shape of the carina on the vertex of the female.

Because there were no specimens available to Schaeffer for study when he presented his review of the genus in 1914, he merely repeated Horn's description. The present description of the male major is in part based on one of Horn's Kansas cotypes which was carefully

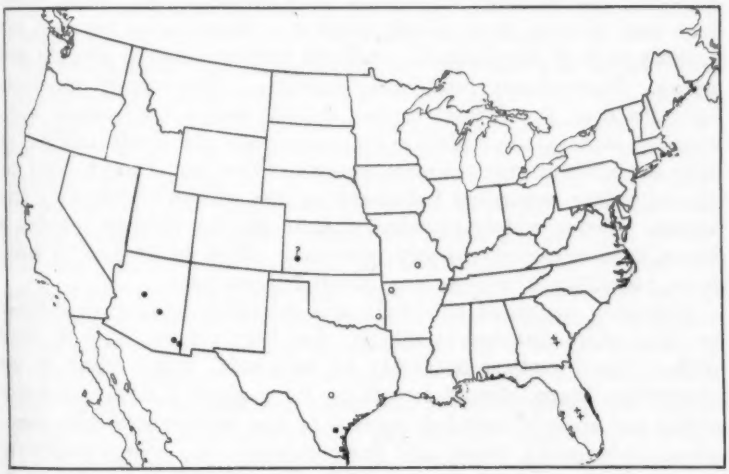

FIGURE 4. Distribution of species of *Onthophagus:*

● *brevifrons* Horn
○ *cavernicollis*, new species
■ *subtropicus*, new species
\+ *depressus* Harold

examined by Howden. About 20 of the specimens seen apparently were collected in 1920 by H. H. Kimball at Paradise, Ariz.; 41 were collected in wood rat nests at Portal, Ariz., in September 1960 by Howden. The writers found a few specimens and fragments a mile east of Portal in wood rat nests in late June 1956. The Arizona specimens are almost identical with Horn's Kansas specimens except that the eyes are narrower and the specimens appear darker, with only occasional traces of greenish lustre on the head of a female.

Although no recently collected specimens from Kansas have been seen, the Kansas label of the type series (collected by Dr. H. A. Brons) should be accepted because at least two species of wood rats occur in the state.

The unconnected distribution can at present be explained only by the seemingly restricted habits of *O. brevifrons*, the only biological information being that they occur in the soil under the large stick nests of the wood rats (*Neotoma* species).

Onthophagus subtropicus, new species

PLATE 2, FIGURES 8 AND 11

HOLOTYPE.—Male, length 8 mm., width 4.5 mm. Head and pronotum shining, dark blackish green; elytra black, alutaceous, weakly shining. Clypeus arcuate, margin moderately reflexed over anterior half; disc densely, shallowly, moderately punctate, with some anastomosing and tendency to rugosity near edges; clypeal carina rather high and distinct over middle third of a raised area between the interior ends of the distinctly carinate sutures between clypeus and genae. Frons closely, moderately punctate, a few coarser punctures laterally near the frontal carina; frontal carina moderately high, strongly sinuate, the middle and ends arcuate posteriorly and not as high at middle as near the ends; somewhat finer punctures behind the frontal suture, separated 1 diameter or less, otherwise minutely alutaceous. Genae widely rounded, margin joining clypeus without a break, surface closely coarsely punctate. Eyes wider than in *brevifrons*, two-fifths as wide as long, about 7 facets wide.

Pronotum margined anteriorly and laterally, basally very finely so for a short distance at middle; disc very convex, high in front with a broad vertical concavity on each side; upper edges of the concavities sharp, almost cariniform for a short distance; anterior angles not sharply rounded; surface of disc everywhere with close, mixed, moderately coarse and fine punctures, the coarse punctures separated by a diameter or more, the fine punctures everywhere in between; surface otherwise smooth and shining except for alutaceous sculpture narrowly across the base. Elytra strongly alutaceous,

striae shining; strial punctures distinct, slightly crenating the intervals; intervals flat with irregular rows of widely spaced fine tubercles. Pygidium alutaceous throughout, with scattered, moderately fine, shallow punctures slightly closer laterally and apically. Ventral surfaces smooth and shining; metasternum with very fine, scattered punctures at middle and moderate punctures forward and to sides; terminal abdominal segment with a single transverse row of setigerous punctures scarcely larger than those of the preceding segment; segment narrowed apically to receive the pygidium. Forelegs slightly longer and thinner than in the female.

ALLOTYPE.—Female, length 8 mm., width 4.5 mm. Shining; head black in front of clypeal carina, green behind; pronotum dark bluish green, elytra black. Clypeus narrowly reflexed anteriorly, gradually less so to genae; broadly truncate-emarginate at middle; disc moderately, transversely punctate-rugose, most of the punctures anastomosing and more or less indistinct; clypeal carina with narrow band of close fine punctures on anterior slope, carina almost angularly higher at middle. Frons quite closely punctate, the punctures separated by 1 to 2 diameters; punctures fine anteriorly to moderately coarse at frontal carina; frontal carina weakly arcuate posteriorly, low and sharp medially, elevated each side to a high, acutely tipped tubercle; tips of the tubercles slightly nearer the middle than to the edges of the eyes; occiput, moderately finely punctate, more coarsely so around the tubercles to the eyes. Genae closely coarsely punctate, many of the punctures anastomosing; margin evenly obtusely rounded to clypeus with only a tiny notch marking the juncture.

Pronotum finely margined, faintly and very finely so basally; disc strongly convex, a wide, vague prominence in front with a shallow vertical concavity on each side; anterior angles not sharply rounded; surface everywhere with close mixed moderate and fine punctures, the moderate punctures separated by 1 to 2 diameters; surface otherwise smooth except for very fine alutaceous sculpture narrowly along the base. Elytra alutaceous except at shoulders; striae shining and sparsely, shallowly punctate; intervals flat, the first with one, the second with two and part of a third, and the next four with two irregular rows of fine tubercles, separated by four to six or more times their diameters; tubercles overhanging setigerious punctures but the setae so short as to be almost invisible. Pygidium apically convex and shining, alutaceous basally; scattered fine punctures becoming closer and deeper apically. Ventral surfaces smooth and shining; metasternum with a distinct, shallowly impressed midline, some fine scattered punctures at middle, and moderate to coarse punctures forward and to sides. Abdominal segments finely alutaceous, each with transverse row of very fine tubercles overhanging very fine setae; setae relatively short

and scarcely longer than the distance between them; apical segment with an irregular band of coarse punctures separated by about a diameter. Legs normal for females of the genus.

TYPE.—USNM 65682.

TYPE LOCALITY.—Laguna Madre, 25 mi. southeast of Harlingen, Tex.

SPECIMENS EXAMINED.—3.

DISTRIBUTION.—(See fig. 4, p. 29.)

TEXAS: Holotype, ♂, Laguna Madre, 25 mi. southeast of Harlingen, Sept. 20, 1945, D. E. Hardy and V. L. Woolley, nest of *Neotoma micropus* Baird (Robinson coll., USNM). Allotype, ♀, Brownsville, Mar. 12, 1908 (Jones and Pratt coll., USNM). Paratype, ♀, Kingsville (C. T. Reed coll., CU).

REMARKS.—This species is very closely related to *O. brevifrons* and *cavernicollis* and is intermediate in size. In *brevifrons*, the color is all black; in *cavernicollis*, the largest species, the pronotum is a bright, shiny green; in *subtropicus*, the pronotum is not so shiny and is a bluish or blackish dark green. The females of *subtropicus* may be separated from the other two species by the shape of the frontal carina, which is elevated on each side to a sharp median tubercle, the tips of the tubercles being nearer the middle of the carina than to the eyes. In *brevifrons*, this carina is wider and slopes evenly from the middle to elevated rounded ends which are nearer to the eyes than to the middle of the carina; the carina ends on each side in a sharp vertical drop to the head surface. In *subtropicus*, the tubercles slope evenly away from their tips in both directions. In *cavernicollis*, the frontal carina is similar to *brevifrons*. The eyes of *cavernicollis* are larger and wider, being a third as wide as long, 7 to 8 facets wide; those of *subtropicus* are two-fifths as wide as long, 6 to 7 facets wide; those of *brevifrons* are sometimes no more than a fourth as wide as long and only 4 to 5 facets wide. In *brevifrons*, there is a greater disparity in the sizes of the pronotal punctures, with the coarse punctures closer together.

The holotype may be a male minor.

The type locality (given on the label as 25 mi. southeast of Harlingen) was placed by a speedometer reading. Dr. Hardy informed us the exact locality would be on the Laguna Madre about 10 miles northwest of Port Isobel in an area used by Harlingen Air Force Base for its gunnery school.

Onthophagus cavernicollis, new species

PLATE 3, FIGURES 22 AND 23

O. brevifrons Horn, 1881, p. 76, in part.

HOLOTYPE.—Male major, length 11 mm., width 6.4 mm. Head and pronotum shining, bright green; elytra weakly shining, black;

pygidium shining, dark green; ventral surfaces, excluding tibiae, black with a more or less shining, greenish luster; tibiae dark brown with only a faint greenish cast. Clypeus widely reflexed anteriorly, less so laterally; margin broadly arcuate anteriorly (not even vaguely emarginate as is often the case in unabraded *brevifrons*), becoming sharply rounded laterally near the genae; disc concave near the center, with coarse punctures shallow and usually separated by approximately their own diameters. Clypeal carina obsolete, the base of the clypeus and the anterior portion of the frons medially forming a low rounded hump; frons more finely, closely punctate than clypeus. Gena with arcuate margin slightly flared, surface coarsely punctate. Carina of vertex raised medially to a point, low and bowed on each side, terminating near the base of the eyes, similar to that described for *brevifrons*; scattered coarse punctures behind the carina, with smooth surfaces finely alutaceous.

Shape of pronotum nearly identical with that of the male major of *brevifrons*, the only differences in the pronotum of *cavernicollis* being in the posterior, vaguely indented median line and in the punctures (also a mixture of large and small ones) which are not as sharply delimited and appear slightly smaller and shallower. Most of the large punctures bearing short, inconspicuous, reddish setae. The convexity of the pronotum seemingly more pronounced than normal in *brevifrons*, but this apparent variation is perhaps an illusion caused by the overall larger size of *cavernicollis*. The elytra likewise very similar to those of *brevifrons*, differing only slightly by having smaller tubercles on the intervals. Pygidium with scattered irregular punctures bearing short, fine setae; the surface basally alutaceous, becoming somewhat shiny and rugose near the apex, the smooth areas dull green. Ventral surfaces and legs lacking any characteristics, other than color, that would readily separate *cavernicollis* from *brevifrons*.

MALE MINORS.—No specimen seen.

ALLOTYPE.—Female, length 11.2 mm., width 6 mm. Differing from the holotype male major in the following respects: Clypeus arcuate but feebly emarginate anteriorly, clypeal margin scarcely reflexed; disc transversely rugose, more closely so than in females of *brevifrons*; clypeal carina pronounced, highest medially, becoming obsolete by the genae. Frons coarsely punctate behind the carina, punctures not so sharply delimited as in *brevifrons*; genae with margin arcuately curving inward by the eyes, anteriorly not delimited from the clypeal margin. Carina of vertex very similar in shape to that described for the female of *brevifrons* but raised terminally to form small horns, the carina extending at least two-thirds the distance from the midline to the eye but still terminating nearly twice as far from

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the eye as in *brevifrons*; a few scattered coarse punctures behind the carina, the smooth areas finely alutaceous.

Pronotum quite convex, tumid anteriorly, but considerably less so than in the male major; the tumosity more rounded but still similar to that of the male, and the lateral concavities much reduced, extending neither to the lateral margins nor to the anterior angles; margin only slightly bent in the anterior third; punctures slightly more pronounced than in the male, but still smaller and more scattered than in *brevifrons*; midline of pronotum slightly depressed posteriorly and with fewer coarse punctures. Elytra not noticeably different from those of the male. Pygidium rather convex apically and more shining than in the male but otherwise similar. Ventrally, differences from the male are noted in the shorter and wider foretibia and in the last abdominal segment, which is not emarginate in the female.

VARIATION.—In the males the length varies from 9.5 to 11 mm., the width from 5.7 to 6.4 mm., and in the females the length varies from 9.1 to 11.2 and the width from 5.4 to 6 mm. The 10 specimens seen exhibit remarkably few noteworthy differences. The brightness of the greenish color of the pronotum is slightly more pronounced in some of the specimens, but in all it is quite evident. In the smaller specimens, both male and female, the pronotal punctures are slightly more pronounced than in larger specimens of the same sex. The male paratypes have the carina of the vertex more sharply indicated laterally than in the holotype, but otherwise the carinae are similar.

TYPE.—USNM 65683.

TYPE LOCALITY.—Waglers Cave, Harrison, Ark.

SPECIMENS EXAMINED.—10.

DISTRIBUTION.—(See fig. 4, p. 29.) Holotype, ♂, and allotype, ♀, Harrison, Waglers Cave, Ark., Apr. 13, 1935, in bat dung, J. M. Valentine. And the following paratypes:

ARKANSAS: Washington Co., Apr. 24, 1938 (INHS). OKLAHOMA: 1 ♀, Tahlequah, Adair Co., Sept. 26, 1954, O. C. Schomberg (LJB). TEXAS: Vicinity "cave without name" near Boerne, Kendall Co., July 30, 1948, G. E. Ball (AMNH); no locality (MCZ); 1 ♀ (ANSP). MISSOURI: 4 ♂♂, 2 ♀♀, Bat Cave, Liking, June 20, 1956, Condé (Muséum National d'Histoire Naturelle, CNC).

REMARKS.—*Onthophagus cavernicollis* can be distinguished from other North American species by its large size and bright, shining green pronotum. Except for size and color, the characteristics listed for separating *O. brevifrons* will also separate this species from the other North American forms. Coloration, size, the smaller pronotal punctures, and the shape of the carina on the vertex of the female will separate *cavernicollis* from either *brevifrons* or *subtropicus*.

In addition to the characteristics given above, the habitat in which the majority of specimens have been taken seems to set the species

apart from the other North American forms. The eight specimens bearing biological data were all taken associated with bat dung in caves. Collecting the specimens in this extremely unusual niche might be considered chance except for the occurrence of a related Mexican species on bat dung in caves. This latter species was described, compared with *brevifrons*, and its biology discussed by Howden, Cartwright, and Halffter (1956). There are probably other species with similarly odd habits. Such an unusual habitat helps explain why *O. carvernicollis* has been so long undescribed and why there are still so few specimens known.

The specimen from Texas, without definite locality, in the collection of the Academy of Natural Sciences of Philadelphia, bears a blue paratype label, No. 3570.3, and is presumably one of the original cotypes of *brevifrons* Horn.

Onthophagus polyphemi polyphemi Hubbard

PLATE 3, FIGURES 14 AND 15

Onthophagus polyphemi Hubbard, 1894, p. 311.—Henshaw, 1895, p. 22.—Schaeffer, 1914, p. 293.—Leng, 1920, p. 248.—Boucomont and Gillet, 1927, p. 207.—Cartwright, 1939, p. 285.—Howden, Cartwright, and Halffter, 1956, p. 10.

MALE MAJORS.—Length 5.5 to 6.9 mm., width 3.5 to 4.1 mm. Dorsal color very dark reddish brown to black, the head and pronotum sometimes slightly darker than the elytra. Clypeus gradually, slightly reflexed anteriorly, truncate, occasionally barely emarginate, laterally slightly arcuate, joining almost evenly with the margin of the gena; disc bearing from 15 to 30 small scattered tubercles, at the base of each tubercle a long reddish seta. Posterior margin of clypeus delimited by a long, very distinct, evenly elevated, strongly anteriorly arcuate carina. Front of head behind clypeal carina nearly flat with a dozen or more widely scattered, setose tubercles; genae scarcely extended laterally, their sides often almost parallel; plane of genae slightly lower than frons and gradually sloping downwards, surface smooth sometimes with two or more setigerous tubercles. Carina of vertex nearly straight, obsolete medially (type series), or distinct for its entire length, being highest laterally; when absent medially, it has the appearance of two small separated carinae, one above each eye (as noted in Hubbard's original description); behind the frontal carina an irregular row of six or more tubercles each with a seta.

Pronotum convex, margined anteriorly, laterally, and obsoletely at middle of base. Pronotal protuberance represented by a broad anterior swelling slightly wider than the head, vague at the middle, more distinct laterally, the steep declivity weakly concave high up at the sides above the anterior angles; anterior angles with scattered, moderate, setigerous punctures, finer and fewer toward middle of de-

clivity; each puncture with a small tubercle in front of the seta, the tubercles disappearing laterally and posteriorly and the punctures becoming much coarser and farther apart, with a few fine punctures intermixed, the surface otherwise smooth and shining. Elytral striae vaguely punctate, intervals smooth and shiny and, except for the sutural one, each with a double row of minute tubercles having setigerous punctures at their bases. Pygidium feebly convex, with scattered, coarse, setigerous punctures, the punctures becoming smaller apically; surface between the punctures finely alutaceous basally, apically almost smooth.

Ventral surfaces and legs reddish brown to black. Antennae reddish brown, the club slightly lighter in color. Proepisternum only slightly excavated to receive antennae. Mesothorax and lateral areas of prothorax and metathorax coarsely setigerously punctate and finely alutaceous. Median area of metathorax smooth and shiny, with scattered nonsetigerous punctures, often with a vague sulcus along the median line. Abdomen except for first segment with a basal row of minute setigerous punctures extending across each segment, last segment narrowed medially. Forelegs approximately the same length as those of female, tibia stoutly and conspicuously quadridentate; outer margin smooth between the teeth, occasionally vaguely serrate above them; conical projection lacking above apical spine. Femora of all legs with numerous setae in an irregular row at their anterior and posterior edges, the flattened ventral surface with scattered coarse setigerous punctures.

MALE MINORS.—Length 4.7 to 6. mm., width 2.7 to 3.7 mm. Very similar to male majors. Anterior clypeal margin slightly less reflexed but of approximately the same shape; clypeal carina and frontal carina less pronounced than in male majors but of the same configuration. Pronotum considerably less convex with pronotal protuberance scarcely evident, disc often with minute scattered punctures. Except for slightly more pronounced punctures and setae on elytra and other parts of body, the male minors do not differ conspicuously from the male majors.

FEMALES.—Length 5.5 to 6.4 mm., width 3.0 to 3.6 mm. Very similar to male minors, the major difference being in the slightly more elongate shape of pygidium and in the last abdominal segment which is not narrowed medially. Little indication of a pronotal protuberance; the punctures and setae usually more in evidence than in the male. Little apparent difference in other aspects (carinae, legs, etc.) between the male minors and the females.

TYPE.—Lectotype, present designation, USNM 1300, a female specimen collected at Crescent City, Fla., July 15 by H. G. Hubbard; deposited in USNM in 1896 as type.

TYPE LOCALITY.—Crescent City, Fla.
SPECIMENS EXAMINED.—159.
DISTRIBUTION.—(See fig. 5.)

FLORIDA: Crescent City, 4 mi. north of High Springs, Gainesville, Leesburg, Lutz, Miami, Stemper. SOUTH CAROLINA: Tillman.

REMARKS.—This moderate-sized species is quite distinct from other American *Onthophagus*. It can be separated by its uniformly shining, dark brownish-black dorsal surface, the presence of small tubercles with setigerous punctures at their bases on the head and near the anterior pronotal angles, the smooth shining disc of the pronotum, the smooth margin of the fore tibia between the four teeth, and the lack of pronounced sexual differences, the male majors having only a widely rounded pronotal protuberance and the forelegs being the same length as those of the female. Pronounced tubercles, setae, and punctures on the head, pronotal angles, and elytra will separate typical *polyphemi* from the west Florida, Alabama, Mississippi subspecies subsequently described.

O. polyphemi polyphemi and its subspecies have been collected only in the burrows of the gopher tortoise, *Gopherus* (*Xerobates*) *polyphemus*. Adult specimens have been collected in March, June, July, and August, appearing freshly emerged in March. Hubbard (1894, p. 305) stated, "I did not find this beetle in the few galleries examined in the winter, and it was probably in pupa at that season." In July it was not rare.

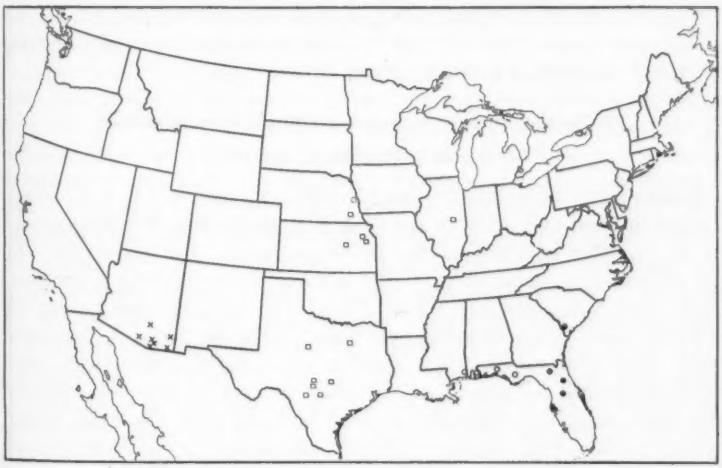

FIGURE 5. Distribution of species of *Onthophagus:*

□ *knausi* Brown
X *höpfneri* Harold
● *polyphemi polyphemi* Hubbard
○ *polyphemi sparsisetosus*, new subspecies

One of the burrows produced 21 specimens. "Its larva was not seen." At the present writing the larva is still unknown.

Collecting even the adults is a difficult job, best accomplished by at least partial excavation of the gopher burrow. In the spring it is often unnecessary to excavate the burrow completely, the *Onthophagus* being found 4 to 8 feet inside the entrance in the sand at the sides of the burrow. Excavation of the complete burrow is quite difficult because they are often 18 to 20 feet long and may reach a depth of 8 to 12 feet. Hubbard, who first investigated the insects associated with the gopher tortoise, wrote (1894, p. 303), "The excavation was in the loose yellow sand of our pine woods subsoil, and when my exploration was completed, so large a pit had been dug that a coach and span of horses might have been swallowed up in it." The authors found Hubbard's statement very true, the only detail seemingly omitted that, when possible, the gopher seems to terminate its burrow under the roots of a tree, adding to the already difficult job of excavation.

Occasionally specimens may be procured by the simple process of placing a trap can containing fermenting malt and propionic acid inside the entrance of the burrow and then sealing the burrow with cardboard, paper, sticks, and sand. The next day, if the can is not filled with sand by the tortoise, it often yields a number of the insects residing in the burrow. A few *Onthophagus* have been taken in this manner.

Typical *O. polyphemi polyphemi* seems to occur in the sandhill regions of the east coast from central Florida to southern South Carolina, wherever the gopher tortoise occurs.

Onthophagus polyphemi sparsisetosus, new subspecies

PLATE 3, FIGURES 16 AND 17

HOLOTYPE.—Male major, length 6.6 mm., width 3.8 mm. Very similar in form and color to the typical *p. polyphemi*, differing largely in the number and size of the tubercles, setae, and punctures. In the following description only the features distinguishing *p. sparsisetosus* from *polyphemi* are given: Head with clypeal disc having 12 or fewer small punctures with tuberculate anterior margins, punctures often with fine setae; frons smooth and nearly impunctate, only seven punctures being evident; low carina of vertex complete, slightly gradually depressed medially, highest laterally near the eyes; vertex behind carina with a row of coarse punctures; genae smooth and impunctate.

Pronotum similar in size, outline, and shape of protuberance to that of typical *polyphemi*; pronotal surface impunctate except near

anterior angles, along anterior margins, and with scattered fine punctures near posterior edge, the punctures anteriorly finely tuberculate at front margins and usually bearing long reddish setae. In *polyphemi*, the punctures are more numerous anteriorly, with conspicuous tubercles. Posterior half of pronotal midline shallowly but distinctly impressed. Elytral striae shallow, faintly punctate; intervals impunctate or nearly so except marginally, second and third intervals impunctate on discal portion or having no more than five small punctures which are slightly tuberculate anteriorly; other intervals punctate, but with tubercles and setae much less conspicuous than is typical for *polyphemi*. Pygidium with scattered coarse setigerous punctures, punctures nearly obsolete medially. Ventral surfaces very similar to typical *polyphemi*, but with punctures slightly reduced in number and size. Punctures of legs reduced but similar otherwise.

MALE MINOR (PARATYPE).—Length 4.5 mm., width 2.7 mm. Except for differences in punctures, tubercles, and setae, the morphological modifications of the male minor are the same as described for typical *polyphemi*. Head in the male minor with setae of clypeus and frons more obvious. Pronotum with punctures and setae more pronounced and slightly more numerous; pronotal disc with many minute punctures scattered over surface, all lacking setae. Second and third elytral intervals nearly impunctate, with even fewer punctures than in holotype. Pygidium with smaller punctures and surface less alutaceous than in male major. Ventral surfaces not noticeably differing from male major.

ALLOTYPE.—Female, length 5.7 mm., width 3.3 mm. Differing from male major in the same ways as described for typical *polyphemi*. Disc of clypeus with 16 or fewer setigerous punctures, tubercles at anterior edge of punctures small, smooth surface between finely alutaceous; frons with 12 setigerous punctures; genae largely impunctate. Pronotum sparsely setigerously punctate anteriorly and laterally, impunctate medially except for a few very fine nonsetigerous punctures. In typical *polyphemi* females, the lateral punctures are larger and cover a more extended area, and the secondary punctures are pronounced on fresh specimens. Pronotum with posterior half of midline shallowly impressed. Second interval of the elytra lacking tubercles, the third with only one or two tuberculate punctures, none of the intervals with the fairly regular one or two rows of setigerous punctures noted in *polyphemi*. Ventral surfaces of the two subspecies similar, with *sparsisetosus* having the number and size of the setae and punctures somewhat reduced.

VARIATION.—In the paratypic series, length ranges from 4.5 mm. to 6.9 and width from 2.7 to 3.9 mm. There is some variation

in the number of punctures on the clypeus and frons, with male minors and females usually having several more punctures than is normal for male majors. Usually the punctures and setae are more pronounced in females than in males, particularly on the pronotum and elytra. Sexual differences and the variation in the males have already been noted. Variation in other respects is small. The topotypic series and the few Mississippi specimens usually have the pronotum shallowly indented along the posterior portion of the midline. West Florida specimens lack the distinct indentation, but otherwise are similar.

TYPE.—USNM 65684.

TYPE LOCALITY.—6 mi. southwest of Stapleton, Ala.

SPECIMENS EXAMINED.—137.

DISTRIBUTION.—(See fig. 5, p. 37.) Holotype, ♂, and allotype, ♀, 6 mi. southwest of Stapleton, Ala., Apr. 19, 1957, Howden and B. Dozier, in gopher tortoise burrow. Also the following paratypes:

ALABAMA: 46 ♂♂, 55 ♀♀, same data as type. FLORIDA: 9 ♂♂, 7 ♀♀, near Clarksville, Mar. 21, 1954, H. Howden, in gopher tortoise burrow; 6 ♂♂, 6 ♀♀, Funiak [De Funiak Springs?]. MISSISSIPPI: 3 ♂♂, 3 ♀♀, 6.5 mi. south of Lucedale, Apr. 20, 1957, H. and A. Howden, in gopher tortoise burrow. Paratypes deposited in CNC, USNM, and B. Dozier coll.

REMARKS.—Though *p. sparsisetosus* apparently has habits identical to those of *p. polyphemi*, it seems advisable to separate the forms for both morphological and geographical reasons. Many species of Scarabaeidae occur in both northern and western Florida, but for many others species the Apalachicola River and adjacent swamps appear to be at least a partial barrier between the two areas. The genus *Mycotrupes* is an example of genera that occur in central and northern Florida but do not extend into western Florida, even though suitable habitats exist (Olsen, Hubbell, Howden, 1954). Other species such as *Serica rhypha* Dawson and *Gronocarus autumnalis* Schaeffer extend at least as far eastward as Clarksville, Fla., but have not been recorded east of the Apalachicola River. *O. p. sparsisetosus* is accorded subspecific status because the dorsal punctures, slightly reduced in size and number, of specimens north (Tillman, S.C.) and west (High Springs, Fla.) of Crescent City (type locality) indicate possible intergradation.

As with typical *polyphemi*, the larvae of *sparsisetosus* are unknown. The adults from western Florida, Alabama, and Mississippi were all collected in the spring (March and April) a short distance inside the entrance of the gopher tortoise burrows. The Alabama series of 103 specimens was taken from a single burrow from 1 to 12 feet inside the entrance. Most of the beetles were in small sandy cells in the sides of the burrows. The few Mississippi specimens were taken on a warm (82°–84°F) cloudy April day. One specimen

was on the pile of dirt outside the burrow, and the other specimens were just inside the entrance. Movement of adults from one burrow to another may possibly occur on warm cloudy days or late in the afternoons.

O. polyphemi sparsisetosus may be distinguished from other North American species by the characters given under typical *polyphemi*. It may be separated from typical *polyphemi polyphemi* by the greatly reduced number of punctures, setae, and tubercles. The nearly impunctate second elytra interval seems always to separate *p. sparsisetosus* from the more eastern *p. polyphemi*.

***Onthophagus striatulus striatulus* (Palisot de Beauvois)**

PLATE 3, FIGURES 18–21

Scarabaeus janus Panzer, 1794, p. 5 (not Olivier 1789, p. 101).—Melsheimer, 1806, p. 3.

Onthophagus janus (Panzer) Dejean, 1836, p. 158.—Sturm, 1843, p. 108.—Haldeman and LeConte, 1853, p. 54.—Lacordaire, 1856, p. 108.—LeConte, 1863, p. 36.—Gemminger and Harold, 1869, p. 1034.—Horn, 1875, p. 139.—Austin, 1880, p. 25.—Henshaw, 1885, p. 87.—Blatchley, 1910, p. 919.—Schaeffer, 1914, p. 296.—Leng, 1920, p. 249.—Boucomont and Gillet 1927, p. 206.—Boucomont, 1932, p. 302.

Onthophagus niger Melsheimer, 1806, p. 3; 1846, p. 134 (nomen nudum).—Haldeman and LeConte, 1853, p. 54.—Lacordaire, 1856, p. 109.—LeConte, 1863, p. 36.—Gemminger and Harold, 1869, p. 1030.—Horn, 1875, p. 139.—Leng, 1920, p. 249.—Boucomont and Gillet, 1927, p. 206.

Copris striatulus Palisot de Beauvois, 1809, p. 92.

Onthophagus striatulus (Palisot de Beauvois) Sturm, 1826, p. 178.—Dejean, 1836, p. 158.—Sturm, 1843, p. 108.—Haldeman and LeConte, 1853, p. 54.—Lacordaire, 1856, p. 109.—LeConte, 1863, p. 36.—Gemminger and Harold, 1869, p. 1030.—Crotch, 1874, p. 57.—Horn, 1875, p. 139.—Austin, 1880, p. 25.—Henshaw, 1885, p. 87.—Blatchley, 1910, p. 919.—Schaeffer, 1914, p. 296.—Leng, 1920, p. 249.—Boucomont and Gillet, 1927, p. 206.

Onthophagus cervicornis Kirby, 1825, p. 565.—Gemminger and Harold, 1869, p. 1030.—Horn, 1875, p. 139.—Leng, 1920, p. 249.—Boucomont and Gillet, 1927, p. 206. (The habitat of *O. cervicornis* Kirby was given as, "Georgia Amer.?" The two horns were described, however, as "erectis arcuatis subramosis." Since no U.S. species has branched horns, perhaps the true *cervicornis* is an African species.)

Onthophagus cavicornis Haldeman and LeConte, 1853, p. 54.—Lacordaire, 1856, p. 108.—LeConte, 1863, p. 36.

Onthophagus castaneus Melsheimer, 1845, p. 134.—Haldeman and LeConte, 1853, p. 54.—Lacordaire, 1856, p. 109.—LeConte, 1863, p. 36.—Gemminger and Harold, 1869, p. 1030.—Austin, 1880, p. 25.—Leng, 1920, p. 249.—Boucomont and Gillet, 1927, p. 206.

Onthophagus viridicollis Gemminger and Harold, 1869, p. 1030.

Onthophagus scabricollis Horn, 1875, p. 139.—Austin, 1880, p. 25.—Leng, 1920, p. 249.—Boucomont and Gillet, 1927, p. 206.

Onthophagus canadensis Horn, 1875, p. 139 (not Fabricius, 1801, p. 34).—Austin, 1880, p. 25.—Leng, 1920, p. 249.—Boucomont and Gillet, 1927, p. 206.

Onthophagus subaeneus Horn, 1875, p. 139 (not Palisot de Beauvois, 1811, p. 105).—Austin, 1880, p. 25.—Henshaw, 1885, p. 87.—Blatchley, 1910, p. 919.

Onthophagus concinnus Horn, 1875, p. 139 (not Laporte, 1840, p. 87).—Leng, 1920, p. 249.

Onthophagus protensus Horn, 1875, p. 139 (not Melsheimer, 1845, p. 134).—Austin, 1880, p. 25.—Leng, 1920, p. 249.—Boucomont and Gillet, 1927, p. 206.

Onthophagus orpheus Horn, 1875, p. 139 (not Panzer, 1794, p. 5).—Austin, 1880, p. 25.—Henshaw, 1885, p. 87.—Blatchley, 1910, p. 919.

MALE MAJORS.—Length 5.2 to 6.8 mm., width 3.2 to 4.1 mm. Color extremely variable, some uniform brown, piceous, or black with iridescent cupreous reflections; some with head and pronotum brown, piceous, or black with iridescent reflections and with elytra brown, piceous, or black except near the apex and base where they are lighter in color, yellow or brown, and form either isolated spots or a basal or apical band. Head with clypeus prolonged, anteriorly reflexed, usually rounded, occasionally broadly emarginate, laterally normally slightly arcuate and extending obliquely to the gena from which it is separated by a faint notch. Clypeus flared laterally in occasional specimens, each side being strongly arcuate and separated from the gena by a distinct notch. Disc of clypeus flat or slightly concave, smooth, and shiny, with a few widely scattered fine or moderate punctures; laterally sometimes coarsely punctate, the punctures occasionally bearing fine short setae. Clypeal carina absent. Frons and base of clypeus flat or slightly convex, smooth, shiny, and lightly to moderately punctate; genae delimited from clypeus and frons by a faint line. Surface concave in front of eyes; surface of vertex lacking a carina, but with a long arcuate horn inside and behind each eye, the horns often reaching a height equal to the top of the pronotal convexity.

Pronotum narrowly margined anteriorly and laterally; anterior angles abruptly, often arcuately rounded and directed outward; lateral margins either arcuate or sinuous, but not sharply bent in anterior half. Pronotum convex, with a large anterior median hump or tumosity which may have an inverted U or V shape or be nearly truncate anteriorly, normally with a concave groove on each side in which the horns of the head may repose. Except for the anterior concavities which may be smooth, shiny, and nearly impunctate, surface of pronotum coarsely punctate, each puncture bearing a short white seta; punctures separated by approximately 1 diameter, the shape of the punctures exhibiting considerable variation, some being shallow and circular, others being deep and circular, often, whether shallow or deep, with a small tubercle indenting the anterior margin; anteriorly on the pronotal tumosity, tubercles often more evident than the punctures, but elsewhere punctures are 2 to 3 times the width of the tubercles.

Elytra with punctate striae, which may or may not be noticeably impressed; intervals shallowly convex or flat with two to three irreg-

ular rows of setigerous tubercles; surface of elytral intervals between the tubercles alutaceous, dully shining. Pygidium largely smooth and shiny with numerous setigerous punctures. Ventral surfaces of thorax laterally bearing large, shallow, setigerous punctures; medially the punctures obsolete, setae shorter, with smooth midline of metasternum lacking both coarse punctures and setae. Abdominal segments finely alutaceous, each segment having an irregular basal row of setigerous punctures, last segment slightly emarginate medially. Forelegs not greatly elongated, tip of the forefemora barely extending to lateral pronotal margin; foretibia quadridentate, slightly longer and considerably more slender than in females, and with an apical conical projection which is lacking in females; outer margin of the foretibia between and above the teeth serrate or finely denticulate; mesothoracic and metathoracic legs similar to those of females; femora of all legs with fairly numerous coarse setigerous punctures.

Male minors.—Length 4.5 to 5.8 mm., width 3 to 4 mm. Differing from male majors in following respects: Dorsal color fully as variable but dark specimens usually with less cupreous iridescence. Head with clypeus not prolonged anteriorly, usually evenly rounded, occasionally broadly, shallowly emarginate; surfaces of clypeus, frons, and genae generally as described in male majors. Carina of vertex often obsolete except laterally where the horns may be reduced to two small sharp humps or are intermediate in length to the male majors; in very small specimens, nearly the entire carina may be indicated as a low ridge, indistinct only at the middle, with no indication of lateral horns.

Pronotum weakly convex, anterior angles acute with lateral margins generally evenly arcuate, protuberance often indicated by a slight swelling delimited laterally by two small rounded or sharp humps, with small concavities beyond them; pronotal punctures as variable as in male majors, but usually more closely grouped. Elytra with the same variable color patterns, tubercles on the intervals usually quite pronounced, as is the alutaceous sculpture. Pygidium often more alutaceous in upper half, setigerous punctures large and close; ventral surfaces generally more heavily punctate. Foretibia shorter, wider, and with only a faint indication of the apical conical projection noted in male majors.

Females.—Length 4.3 to 7.2 mm., width 2.5 to 4 mm. Differing from male majors in the following respects: Head with clypeus rounded, the anterior edge often truncate or very slightly emarginate for a short distance, the margin reflexed anteriorly, less so laterally; disc coarsely transversely rugose; clypeal carina low, complete, highest medially, laterally often only a raised line by the genae; frons and genae with scattered, coarse, setigerous punctures usually separated by a

distance of several diameters; frontal carina complete, of low to moderate height, often lowest medially and abruptly terminated laterally, usually straight or slightly sinuous when viewed from above; vertex behind the carina smooth except for a few scattered punctures.

Pronotum weakly convex, the features as described in male minors, except that in females the tubercles overhanging the pronotal punctures are often more pronounced. Elytra with the same features and varying no more than male minor from the male major. Pygidium more convex, otherwise similar to the males. Ventral surfaces with the punctures slightly more pronounced, similar to the males except that the last abdominal segment is not narrowed medially. Foretibia short, quadridentate, with teeth larger than in male majors and margin of tibia between the teeth serrate or denticulate; lacking apical conical projection noted on the foretibia of male majors.

TYPE.—Unknown to writers.

TYPE LOCALITY.—"Etats-Unis (Caroline du Sud)."

SPECIMENS EXAMINED.—1646.

DISTRIBUTION.—(See fig. 1, p. 17.) Nebraska, Oklahoma, Texas, and all States east of these except possibly New Hampshire and Maine. No records from Canada.

REMARKS.—This species presents interesting problems. Several forms have been described, and because all have similar habits, it has been difficult to decide upon the limit of variability for certain populations. The unicolorous form and the bicolored specimens are considered a single species owing to their sympatric distribution and variable and overlapping morphological characteristics. The form *O. floridanus* Blatchley is subsequently listed and described as an allopatric subspecies (p. 45). Many of the characteristics of *s. floridanus*, such as tuberculate-punctate pronotum and black color, appear separately in populations of *s. striatulus*, but of the many specimens examined none with a range outside the southeastern coastal plain exhibited all the characteristics of *s. floridanus*. This fact coupled with the restricted distribution of *s. floridanus* would seem to make valid its recognition as a subspecies.

O. striatulus is the most variable North American species of the genus, but is easily recognized if a male major is in the series. The two long horns on the head, which fit on each side of the pronotal protuberance, the coarsely punctured pronotal disc (tubercles sometimes at the anterior margin of the punctures), tuberculate-granulate elytral intervals, and the varied color which is never dull black distinguish the male majors. The male minors and females with the evenly rounded or slightly emarginate clypeus, coarsely punctate pronotum, tuberculate-granulate elytral intervals, varied color, and conspicuous setae both dorsally and ventrally can be rather easily separated from

all the related species except the females of the *orpheus* complex. Male minors and females of *s. striatulus* may be distinguished from these species by the fine alutaceous sculpture of the elytral intervals which is lacking in the *orpheus* group. The similarity of the females of these species probably led Blatchley to confuse *orpheus* as a variety of *striatulus* in his "Coleoptera or beetles known to occur in Indiana" (1910, p. 919). Blatchley (1916, p. 95) also stated that *O. janus* and *striatulus* are good species, but his reasons for this separation are not valid.

Onthophagus striatulus is fairly distinct from other North American *Onthophagus* in its habits inasmuch as it prefers rotting fungi to dung as adult food. Specimens can be commonly taken under some of the "toadstool" fungi and have also been found by the writers on a species of *Rhizopogon*. They can be easily taken in sunken can traps baited with bananas, fermenting malt, or malt and propionic acid. Specimens less frequently are taken on rotten melons, animal droppings, or carrion. Brown (1928) found *striatulus* attracted to baits of decaying bananas in damp forests.

In provisioning larval food, however, *s. striatulus* seems to follow the typical pattern of providing dung for the larvae. A number of adult *s. striatulus* collected at Bastrop State Park, Texas, on rotting watermelon during mid-June were placed in a large soil-filled flower pot, furnished with fungi and cow dung, and left undisturbed until July 5th. At that time, the pot was investigated and four cells composed of dung were found at depths of 3, 4, and 5 inches. Each cell contained a single larva. All the larvae, 2 second instars and 2 third instars, were immediately preserved. The cells were oval in shape, 12 to 14 mm. long, and 8 to 10 mm. wide at the widest point, with the cavity containing the larva at the upper end. In none of the cells was there any indication of fragments of fungi, even though fungi was placed in the pot and the adults appeared to feed on it. After July 5th no additional cells were formed. Development of *O. striatulus* seems typically rapid, the third instars taking no more than 3 weeks to develop from the egg. Pupation evidently occurs in midsummer, for numerous, seemingly freshly emerged adults are common on fungi in September in Tennessee.

Onthophagus striatulus floridanus Blatchley, new combination

PLATE 4, FIGURES 24 AND 25

Onthophagus nigrescens Blatchley, 1916, p. 94 (not d'Orbigny, 1902, p. 21).—Leng and Mutchler, 1933, p. 38.

Onthophagus floridanus Blatchley, 1928, p. 128.—Leng and Mutchler, 1933, p. 38.

MALE MAJORS.—Length 5.9 to 7.1 mm., width 3.7 to 4.3 mm. Dorsal color shining black with vague greenish cast. Head with

clypeus prolonged anteriorly, usually evenly rounded, occasionally sharply emarginate. Other features of head as described for *s. striatulus*. Pronotum with margins, angles, and protuberance as described for *s. striatulus;* punctures shallow and poorly defined, anterior margin of each puncture with a pronounced tubercle which bears a short whitish (not usually blackish as stated by Blatchley, 1916, p. 94) seta at its base, often appearing more tuberculate than punctate. Elytra as described for *s. striatulus* except that the surface of the intervals between the tubercles is smooth and shiny, not alutaceous as in *s. striatulus;* tubercles of the intervals in two or three irregular rows, each tubercle with a short white seta at its base. Pygidium and ventral surfaces black and shining with morphological characteristics falling within the limits described for *s. striatulus*.

MALE MINORS.—Length 5.5 to 5.9, width 3.3 to 3.5 mm. Seemingly infrequent in the population. Color black, shining, rarely vaguely greenish. Pronotal tubercles pronounced with whitish setae more evident than in male majors. Elytral intervals still smooth between the two or three rows of tubercles. In other features (carinae of head, pronotal modifications, length of foretibia, etc.) male minors of *s. floridanus* resemble those of *s. striatulus*.

FEMALES.—Length 6.8 to 7.2 mm., width 3.8 to 4.2 mm. Dorsal color shining black, occasionally faintly greenish. Pronotal tubercles more pronounced than in males, punctures shallow. Setae on pronotum, elytral intervals, and ventral surfaces whitish and conspicuous. Elytral intervals between the two or three rows of tubercles smooth and shining. In other respects females of *s. floridanus* resemble those of *s. striatulus*.

TYPE.—Purdue University, Lafayette, Ind.

TYPE LOCALITY.—Dunedin, Fla.

SPECIMENS EXAMINED.—107.

DISTRIBUTION.—(See fig. 1, p. 17.)

GEORGIA: Alma (Bacon Co.). FLORIDA: Bartow, Crescent City, Dunedin, Gainesville, High Springs (Columbia Co.), Lutz, Miami. SOUTH CAROLINA: Aiken, Bulls Island, Goose Creek (Berkeley Co.), Hampton, Longs (Waccamaw River), Marion, Meredith, Summerville. (Fifteen additional specimens from Dunedin, High Springs, and Gainesville, Fla., and from Florence, Longs, Meredith, and Scranton, S.C., show varied amounts of faint alutaceous sculpture on the elytra. These should perhaps be considered intermediate forms.)

REMARKS.—The subspecies *O. striatulus floridanus* Blatchley is largely confined to peninsular Florida and the Atlantic Coast northward to Myrtle Beach, S.C. Blatchley took his type specimen, a male, at Dunedin, Fla., on Nov. 1 from a "decaying fleshy fungus." He stated that the pronotal setae were blackish and the elytral setae very fine. In specimens taken by F. N. Young at Miami and in

others taken by Howden in malt cans from central Florida, the setae are whitish and quite conspicuous. In other respects they match Blatchley's description (1916, p. 94).

O. striatulus floridanus may be distinguished from other North American species by the characteristics given under *s. striatulus*. It may be distinguished from *s. striatulus* by the combination of black color, rather tuberculate pronotum, especially posteriorly, lack of alutaceous sculpture, and more distinct tubercles on the elytral intervals. Usually *O. striatulus floridanus* may be separated from *O. orpheus orpheus* and *o. pseudorpheus* by the presence of three irregular rows of tubercles on the second and third elytral intervals.

As mentioned above, food preferences of *O. s. floridanus* are similar to *s. striatulus* in that they are attracted to fungi and may be trapped in cans baited with malt. Nothing is known of the larval habits.

Onthophagus orpheus orpheus (Panzer)

PLATE 4, FIGURES 26 AND 27

Scarabaeus orpheus Panzer, 1794, p. 5.

Onthophagus orpheus (Panzer) Sturm, 1843, p. 107.—Haldeman and LeConte, 1853, p. 54.—Lacordaire, 1856, p. 108.—LeConte, 1863, p. 36.—Gemminger and Harold, 1869, p. 1034.—Blatchley, 1910, p. 919.—Schaeffer, 1914, p. 295.—Leng, 1920, p. 249.—Dawson, 1922, p. 179.—Boucomont and Gillet, 1927, p. 207.—Boucomont, 1932, p. 311.—Howden, Cartwright, and Halffter, 1956, p. 11.

MALE MAJORS.—Length 6.5 to 9.0 mm., width 3.7 to 5.0 mm. Dorsal surfaces dark green, often with blue or coppery reflections, smooth and shining between punctures; ventral surfaces shining piceous, green, vaguely alutaceous between coarse punctures; legs greenish brown or black; antennae brownish black, the club grayish black. Clypeus sharply reflexed anteriorly, arcuate, truncate, or vaguely emarginate; clypeal disc coarsely, rugosely punctate, more so laterally; numerous fine secondary punctures often between the scattered, coarse, setigerous punctures of the clypeus, vertex, and genae; clypeal carina obsolete to barely indicated; carina on vertex obsolete medially, indicated laterally by a single short tubercle or horn above and behind each eye.

Pronotum margined anteriorly and laterally, convex, with a broad anterior process extending over the head, normally extending almost as far as the posterior edge of the clypeus. Process bifurcating over the posterior part of the vertex and with the ends of the bifurcations usually ending in hatchet-shaped tips; the process curving evenly downward when viewed laterally, tips not approaching the clypeus as closely as in *cynomysi*. Pronotal surface with coarse punctures, laterally each bearing a short seta; most punctures except at posterior

midline with a small tubercle at their anterior margins; tubercles, setae, and punctures most pronounced anteriorly and laterally. Elytra with well-defined striae; all intervals except the sutural interval and the anterior portion of the second and fourth intervals irregularly, biserially punctate-tuberculate, the punctures bearing fine, whitish setae; surface between tubercles smooth and shining, not alutaceous.

Pygidium usually coarsely, setigerously punctate. Ventral surface of metasternum laterally alutaceous and coarsely, setigerously punctate, medially with only fine secondary punctures except for a few large posterior ones and a shallow, longitudinal indentation. Abdominal segments coarsely, shallowly punctate laterally, the punctures becoming obsolete medially; last segment emarginate medially to receive pygidium. Legs piceous to brown with a greenish luster. Forelegs with femur and tibia longer than in female, the distal end of the femur extending to the lateral margin of the thorax; tibia with four large lateral teeth with serrate margin between and a conical, apical tooth above the short inturned tibial spine. Femora of mesothoracic and metathoracic legs with scattered coarse punctures and a few very fine punctures on their ventral surfaces.

MALE MINORS.—Length 5.1 to 7.3 mm., width 3.2 to 4.3 mm. Usually smaller than male majors or females, differing from the former in the following respects: Clypeus reflexed only slightly more anteriorly than laterally; clypeal carina distinctly indicated; carina of the vertex usually complete, highest laterally, indicative of the conical tubercles above the eyes in male majors. The pronotal protuberance in the smallest specimens reduced to a small hump resembling that of a female, but slightly narrower in width. Forefemora and tibia not greatly elongate, the tibia with only a trace of the apical conical tooth over the tibial spine which is still short and stubby, not as elongate as in females.

FEMALES.—Length 5.2 to 8.0 mm., width 3.7 to 5.0 mm. Differing from the male majors in the following respects: Clypeus evenly arcuate, shallowly emarginate anteriorly, and faintly to moderately reflexed; disc very coarsely, rugosely punctured, much more so than in males; both carinae of clypeus and vertex pronounced, the latter being more pronounced and slightly higher medially; frons, before the carina, slightly more coarsely punctured than in male and often with scattered secondary punctures. Pronotum with the anterior process evidenced by a rounded, broad hump often angulate and pronounced laterally, the swelling not extending over the anterior margin. Elytra and pygidium similar to those of male but with punctures at base of tubercles on elytra often more pronounced. Prothoracic legs not elongate, the apical end of the femur not extending as far as the lateral margin of the pronotum; tibia proportionately shortened, laterally with four

teeth, apically lacking the conical tooth overhanging the long incurved tibial spine. Mesothoracic and metathoracic femora slightly thicker and shorter than in male majors.

TYPE.—Location unknown to us.

TYPE LOCALITY.—"Americes borealis."

SPECIMENS EXAMINED.—120.

DISTRIBUTION.—(See fig. 6.)

UNITED STATES: FLORIDA: Enterprise, Lake City, Live Oak, Florida Caverns State Park, Key Largo. ILLINOIS: Edwardsville, southern Illinois. INDIANA: LaPorte, Tippecanoe Co. IOWA: Burlington. KANSAS: East Kansas, Lawrence. MARYLAND: Baltimore, College Park, Plummers Island. MINNESOTA: (State label only). NEW JERSEY: Alpine, Cecil, Palisades. NEW YORK: Bear Mountain. OHIO: Adams Co., Champaign Co., Cuyahoga Co., Highland Co., Hocking Co., Licking Co. OKLAHOMA: Payne Co. PENNSYLVANIA: Boyertown, Broomal, Milford, Pittsburgh. SOUTH CAROLINA: Pinnacle Mtn. TENNESSEE: Burrville, Jackson Co. TEXAS: Brazos Co,. College Station, Columbus, Fedor, Hunt Co., Sabinal. VIRGINIA: Alexandria, Fairfax Co. WISCONSIN: Lake Geneva.

REMARKS.—The *Onthophagus orpheus* group, instead of being divisible into several subspecies as treated here, may represent a series of sibling species; however, the taxonomy of the group will remain obscure until a great deal more is known about the biology of the complex. The meagre information at hand seems to indicate that all the subspecies are associated largely with animal nests or burrows.

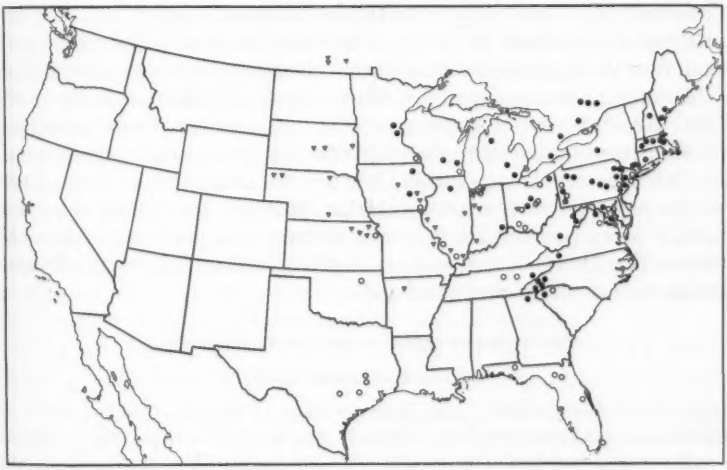

FIGURE 6. Distribution of species of *Onthophagus:*

● *orpheus canadensis* (Fabricius)
○ *orpheus orpheus* (Panzer)
▽ *orpheus pseudorpheus* new subspecies

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This widely ranging form, *O. orpheus orpheus*, seemingly has the most diverse habits in the *orpheus* group, and likewise shows the greatest range of variation. Brown (1926) found *O. orpheus* "about manure in moist woodlands." We have taken occasional specimens on cow or other animal dung, and a few were captured in malt traps. Most of the specimens that we examined that had accompanying biological data had been taken in a variety of situations associated with nests or burrows. One long series from Plummers Island, Md., came from a buzzard's nest; other specimens have been taken in woodchuck, *Marmota monas* (Linnaeus), burrows; still other specimens from Florida have been found in wood rat (*Neotoma* sp.) nests. Eight specimens from Tennessee were taken in a cave, possibly attracted to bat guano (as is *O. cavernicollis*). Inasmuch as most of the species of *Onthophagus* that are not general dung feeders seem to have a very restricted host preference, it seems quite likely that further investigation may show that three or four morphologically similar species with quite diversified habits are placed here under the name *orpheus*. This subspecies is mainly a low elevation or southern woodland form, occurring mainly on the coastal plain in the southeastern United States and along the larger river systems in the midwest. (fig. 6).

Onthophagus orpheus can be recognized by its shining green, reddish-green, or greenish-black color; rounded or broadly shallowly emarginate, never bidentate, clypeus; distinctly punctate pronotum, the punctures with or without anterior tubercles; the broad anterior pronotal hump which in male majors becomes a flat bifurcate projection over the head, and the moderate size, from 5 to 9 mm. in length.

The subspecies *orpheus orpheus* can be distinguished by the small tubercles at the anterior margins of the elytral punctures and often by the pronotal punctures with tubercles; short setae are usually present laterally on the pronotum, but are either lacking or very short at the posterior center portion of the disc; on the elytra, setae are usually present behind the tubercles in the vague punctures. In male majors the clypeal carina is never distinct, and in females the frontal carina is normally highest medially.

Onthophagus orpheus canadensis (Fabricius)

PLATE 4, FIGURES 28–30

Copris canadensis Fabricius, 1801, p. 34.—Palisot de Beauvois, 1809, p. 92.
Onthophagus canadensis (Fabricius) Sturm, 1826, p. 177.—Sturm, 1843, p. 107.—Haldeman and LeConte, 1853, p. 54.—Lacordaire, 1856, p. 54.—LeConte, 1863, p. 108.—Gemminger and Harold, 1869, p. 1034.—Crotch, 1874, p. 57.
Onthophagus ?concinnus (Laporte) Boucomont and Gillet, 1927, p. 207.

MALE MAJORS.—Length 5.5 to 7.0 mm., width 3.5 to 3.8 mm. Dorsal surfaces cupreous to green, smooth and shining between punc-

tures; ventral surfaces green or coppery to black, vaguely alutaceous, shining between punctures; legs greenish brown to black. Head with clypeus sharply reflexed anteriorly, vaguely emarginate, surface rugosely punctate; clypeal carina at most barely indicated; vertex and prominent genae with scattered coarse punctures, some punctures bearing setae; frontal carina represented only laterally, indicated by a single short tubercle above and behind each eye; antennae brownish red, the club grayish brown.

Pronotum convex, with an anterior process extending over the head bifurcating beyond the pronotal margin, the bifurcations ending in blunt hatchet-shaped tips; the process narrowest just posterior to the point of bifurcation, beyond that arcuately increasing in width by approximately one-fifth; from lateral view the process curving downward toward the vertex above the eyes. Pronotum margined anteriorly and laterally, coarsely punctate laterally and on the pronotal process, the punctures becoming shallower and very sparse medially and posteriorly; laterally some of the punctures bearing very short setae which become minute or are absent medially; punctures round or oval and lacking a tubercle at their anterior margin. Elytra with well-defined striae; intervals distinctly, irregularly punctate, the second and fourth intervals poorly so or impunctate, at least in anterior half; setae in the punctures short and inconspicuous, usually absent on the second and fourth intervals; surface strongly shining, not alutaceous.

Pygidium shining; coarsely, setigerously punctate. Ventral surfaces of thorax laterally vaguely alutaceous and coarsely, setigerously punctate; metasternum medially with only fine secondary punctures and a faint longitudinal sulcus. Abdominal segments with numerous punctures laterally, becoming almost impunctate medially, the last segment emarginate medially. Foreleg with femur and tibia longer than in female, the distal end of the femur extending to the lateral margin of the thorax; tibia with four large lateral teeth, the margin serrate between and above the teeth and with a conical apical tooth above the short inturned tibial spine. Femora of mesothoracic and metathoracic legs having a few scattered coarse setigerous punctures and a few, very fine punctures on their ventral surfaces.

Male minors.—Length 3.9 to 6.1 mm., width 2.6 to 3.4 mm. Usually smaller than male majors or females, differing from the former in the following respects: Clypeal margin scarcely more reflexed anteriorly than laterally; clypeal carina usually pronounced; frontal carina often complete, highest laterally, indicative of the conical tubercles above the eyes in male majors. Pronotal protuberance greatly reduced, sometimes only indicated as it is in females by a round hump extending no farther than the anterior pronotal margin.

Forefemur and tibia not greatly elongate, the tibia lacking the apical conical tooth over the tibial spine, the spine however being still rather short and stubby; the four lateral tibial teeth intermediate in size between those of the male major and the female.

FEMALES.—Length 6 to 6.5 mm., width 3.5 to 4 mm. Differing from the male major in the following respects: Clypeus rather evenly arcuate, scarcely emarginate, only sligthly reflexed anteriorly and laterally; disc very coarsely rugosely punctured, much more so than in males; carinae of both clypeus and vertex pronounced, that of the latter usually being slightly more pronounced and highest at the center, occasionally vaguely indented medially; frons before the carina more densely punctured than in male majors, the punctures being separated by only slightly more than their own diameters.

Pronotum similar to male minor with the pronotal process evidenced by a broad hump extending no farther than the anterior pronotal margin. Punctures of the elytra more pronounced than in the majority of males, those of the second and fourth intervals being small, often obsolete; punctures of pygidium more numerous than in males. Prothoracic legs not elongate, the apical end of the femur not extending as far as the lateral margin of the thorax and the tibia proportionately shortened; apical tibial spine long, curved inward near the tip, and lacking the basally overhanging conical projection; laterally the outer margin of the foretibia is serrate between and above the four large teeth. Mesothoracic and metathoracic femora slightly thicker and shorter than in male majors.

TYPE.—Unknown to us.

TYPE LOCALITY.—"Canada."

SPECIMENS EXAMINED.—336.

DISTRIBUTION.—(See fig. 6, p. 49.)

CANADA: ONTARIO: Chalk River, Constance Bay, Marmora, Ottawa, Toronto, Walsingham.

UNITED STATES: CONNECTICUT: Stamford. DELAWARE: Earleville. DISTRICT OF COLUMBIA. GEORGIA: Neel Gap. INDIANA: Ripley Co. ILLIONIS: Ogle Co. IOWA: Iowa City, Clermont. MAINE: Isle of Springs, Sebago Lake. MARYLAND: Baltimore, Beltsville, C. and O. Canal, Forest Glen, Plummers Island. MASSACHUSETTS: Amherst, Ashland, Brookline, Forest Hills, Framingham, Mount Tom, Nantucket, Natick, Sherborne, Springfield, Tyngsboro, Wellesley. MICHIGAN: Adrian, Crawford Co., Livingston Co. MINNESOTA: Anoka Co., Ft. Snelling. NEW HAMPSHIRE: Rumney, Three Mile Id. NEW JERSEY: Cecil, Duttonsville, Greenwood, Stanhope. NEW YORK: Carmel, Groton, Palisades, West Point. NORTH CAROLINA: Black Mts., Highlands, Pisgah Forest, Retreat, Sunburst. OHIO: Ashtabula, Columbus, Delaware Co., Licking Co. PENNSYLVANIA: Angora, Bear Mtn., Bethlehem, Canadensis, Dauphin Co., Davidsburg, Delaware Co., Easton, Forest Co., Frankford, Germantown, Jefferson Co., Lima, Lititz, New Hope, Pecks Pond, Pocono Mts., Roxbourough, State College, Swarthmore, Washington. SOUTH CAROLINA: Sassafras Mt., CCC Camp F2

(Oconee Co.), Pinnacle Mtn. TENNESSEE: Gatlinburg. VIRGINIA: Draper, Mayland, Vienna. WEST VIRGINIA: Lost River State Park, Tucker Co., White Sulphur Springs. WISCONSIN: Madison, Milwaukee Co.

REMARKS.—Of the various forms in the *orpheus* complex, *canadensis* seems to form the most uniform group. The subspecies can be distinguished by the pronotal disc centrally with small nonsetigerous punctures, the punctures lacking tubercles at their anterior margins. The head and pronotum often have a coppery cast that may also be present on the elytra. The elytral intervals, particularly the third and fifth, are distinctly punctate, the punctures lacking tubercles at their anterior margins and with setae fine and inconspicuous. *O. o. canadensis* can be separated from other species of *Onthophagus* in the same manner as typical *orpheus*.

The name *canadensis* is used for this form even though Fabricius did not mention the "coppery color" in his description. However, Palisot de Beauvois (1809) redescribed the "species," supposedly using material taken in "Canada" by the same collector. He also figured *canadensis*, and there can be no doubt about the coppery color. Actually, the coppery cast is not always indicative of the subspecies, but the majority of specimens, particularly those from Canada, show the coppery or reddish hue to some degree.

The subspecies occurs from Ontario and the New England States southward to Maryland and thence down the Appalachian Mountains to South Carolina. Biologically the subspecies seems to be closely associated with the woodchuck, *Marmota monax* (Linnaeus); we have no records of it from any other type of nests or burrows, though a few specimens have been taken on cow dung. It is largely a northern woodland form and occurs only at the higher elevation in the southeastern United States (fig. 6).

Onthophagus orpheus pseudorpheus, new subspecies

PLATE 4, FIGURES 31–33

HOLOTYPE.—Male major, length 8.0, width 4.3 mm. Dorsal surfaces green with a faint coppery cast on the clypeus, frons, and bifurcated portion of the pronotal protuberance; ventral sufaces green to greenish black with tibiae greenish brown; antennal club grayish brown. Clypeus distinctly reflexed anteriorly, noticeably shallowly emarginate medially, sides of emargination broadly rounded; clypeal disc with mixed coarse and fine punctures, slightly more so laterally; many of the coarse punctures with long erect setae; clypeal carina distinct, becoming highest medially where it forms a sharp angle or point. Frons and genae with scattered coarse and fine punctures, most coarse punctures with long, erect setae; frontal carina widely

arcuate, obsolete medially, ending laterally in a short, acute horn above and behind each eye.

Pronotum margined anteriorly and laterally, convex, with a broad anterior process extending over the head almost to posterior edge of clypeus. Process with base and bifurcating arms somewhat thicker than in typical *orpheus*, the process bifurcating over the posterior part of the vertex, the ends of the bifurcations thickened and rather hatchet-shaped; process curving evenly downward, similarly as in typical *orpheus*, when viewed laterally. Pronotal surface with numerous coarse punctures usually separated by less than 1 diameter, most punctures with a small tubercle at their anterior margins; most punctures, including those on the central part of the disc, with long, erect, conspicuous setae that gives the pronotum a much more distinct "hairy appearance" than the other subspecies of *orpheus*; surface between punctures smooth and shining, laterally with some very minute secondary punctures.

Elytra with well-defined, slightly impressed striae; all intervals except the sutural interval and the anterior portion of the second and fourth intervals irregularly biserially punctate-tuberculate, the punctures minute and bearing long, erect, conspicuous setae; surface between tubercles mostly smooth and shining, not alutaceous. Pygidium coarsely, setigerously punctate; medially with fine secondary punctures and a few coarse ones, particularly posteriorly. Midline of metasternum very slightly impressed. Abdominal segments coarsely shallowly punctate laterally, the punctures becoming obsolete medially; last segment emarginate medially to receive pygidium. Legs as described for the male majors of the typical *orpheus* (p. 47).

Male minor.—Paratype, length 6.0 mm., width 3.6 mm. Differing from the male major in the following respects: Clypeus reflexed only slightly more anteriorly than laterally, truncate at anterior edge, not emarginate; clypeal carina slightly higher than that of male major but of same general shape; carina of vertex only vaguely indicated medially, raised laterally in a thin bladelike, sharply arcuate ending above and behind the eyes. Pronotal protuberance still forming a short, flat shelf that extends over the posterior part of the vertex and is deeply emarginate medially (indicative of bifurcation of male major); other male minors lack the pronotal projection, having only a vague median hump that does not extend over the anterior margin. Legs as described for male minor of typical *orpheus*.

Allotype.—Female, length 6.5 mm., width 4.0 mm. Differing from holotype male major in the following respects: Dorsal color almost entirely green; clypeus rather evenly arcuate, shallowly emarginate anteriorly, and faintly to moderately reflexed; disc coarsely, rugosely punctured, much more so than in male. Both carinae

pronounced; clypeal carina rounded, highest medially; carina of vertex highest laterally, slightly lower medially, the lateral ends turned slightly posteriorly and rounded off abruptly to vertex behind eyes; frons before the carina more coarsely punctate than in male. Pronotum with the anterior protuberance evidenced by a rounded hump which is most pronounced and angulate laterally, the swelling not extending over the anterior margin. Punctures, setae, and tubercles of pronotum, elytra, and pygidium slightly more pronounced but similar to those of male major. Prothoracic legs not elongate, the legs and ventral surfaces very similar to those described for typical *orpheus*.

TYPE.—Canadian National Collection 7526.

TYPE LOCALITY.—Onah (30 mi. east of Souris), Manitoba.

SPECIMENS EXAMINED.—110.

DISTRIBUTION.—(See fig. 6, p. 49.) Holotype, ♂, and allotype, ♀, Onah (30 mi. east of Souris), Manitoba, July 9, 1918, J. B. Wallis.[3] And the following paratypes:

CANADA: MANITOBA: 3 ♀♀, same data as type (CNC). 12 ♂♂, 12 ♀♀, Aweme, May 8, 19, 25, June 7, 10, 11, 16, July 20, 23, 26, 28, Aug. 12, 23, Sept. 5, 14, N. Criddle, (AMNH, CNC, USNM, Howden); 2 ♂♂, 1 ♀, Birds Hill, June 15, L. H. Roberts (CNC, Howden); 1 ♀, Treesbank, July 11, 1914, J. B. Wallis (CNC); 1 ♂, 1 ♀, Winnipeg, Hanham (USNM).

UNITED STATES: ARKANSAS: 1 ♂, Carlisle (Liebeck coll., MCZ). ILLINOIS: 1 ♂, Browning, Apr. 8, 1942, Mohn and Burks (INHS). 2 ♂♂, Quincy, June 28, 1883, (Bolter coll., INHS); 1 ♀, Urbana, May 17, 1886, Woodsworth (CNC); 1 ♀, Urbana, Apr. 18, 1915, Fairgrounds (CNC); 2 ♂♂, Urbana, July 1, 13, 1939, P. C. Stone, in nest of *Microtus ochrogaster* (USNM); 1 ♂, Urbana, May 13, 1933, Mohr (INHS); 1 ♂, Vienna, Apr. 17, 1941, Ross and Mohr (INHS); 1 ♂, Willow Spring, June 1, 1924 (Howden); 2 ♂♂, (State label only) (INHS). INDIANA: 1 ♂, Dunes St. Pk., May 9, 1939, H. Dybas (CNHM); 1 ♀, Lafayette, June 5, 1926, (Texas A. and M.); 1 ♂, Lake Co., May 20, 1905, W. S. B. (CU); 1 ♂, Michigan City, July 7, 1935, H. Dybas (CNHM); 1 ♀, Michigan City, Apr. 30, 1935, H. Dybas (Howden); 1 ♂, 3 ♀♀, Pine, May 29, 1905, May 27, 1906, A. B. Wolcott (USNM); 1 ♀, Pine, May 28, 1905, Gerhard (Howden). IOWA: 1 ♂, Ames, May 5, 1941, J. W. Apple (INHS); 1 ♂, Ames, May 25, 1935, B. E. Ferrier (Howden); 1 ♂, Ames, May 22, 1950, W. J. Eckebrecht (IS); 1 ♂, Ames, Apr. 28, 1930, Archie Rolfs (USNM); 1 ♀, Ames, May 17, 1928, T. S. H. (IS); 1 ♂, Ames, May 1941, J. D. Van Eaton (IS); 1 ♂, Ames, Apr. 27, 1927, H. K. R. (IS); 1 ♂, Ames, May 25, 1927, N. H. B. (IS); 1 ♂, Ames, Apr. 14, 1948, R. I. Scott (IS); 1 ♂, Ames, May 26, 1948, L. Tenney (IS); 1♀, Ames, Apr. 23, 1924, (IS); 1 ♂, Ames, May 4, 1931, G. R. Hopping (CAS); 1 ♀, Iowa City, May 12, 1917, L. Buchanan (USNM); 1 ♂, 1 ♀, Iowa City, Apr. 3, Oct. 15, Wickham (USNM); 1 ♀, Mt. Pleasant, Apr. 26, 1937, Milspaugh (USNM). KANSAS: 3 ♀♀, Argentina, Apr. 27, June 4, 1907 (Enns coll.); 2 ♂♂, Douglas Co., May 1920, Oct. 15, 1922, W. J. Brown (CNC, Howden); 2 ♂♂, 1 ♀, east Kansas, April, Popenoe (USNM); 1 ♀, Fairview, September 1929, L. W. Brown (CNC); 4 ♂♂, 2 ♀♀, State label, (CNHM, Purdue);

[3] "Aweme" and "Onah" are names for different parts of the Criddle farm which is 3 miles from Treesbank. Souris, Manitoba, is 30 miles to the west.

1 ♂, Riley Co., Apr. 30, Kimball (USNM); 1 ♂, Topeka, Apr. 8, Popenoe (USNM); 1 ♀, west Kansas, Popenoe (USNM). MINNESOTA: 1 ♂, 1 ♀, State label, (Blanchard coll., MCZ; Howden). MISSOURI: 2 ♀ ♀, St. Louis, June 17, 1935, U.S.D.A. traps, (Enns coll.); 1 ♂, 3 ♀ ♀, St. Louis, April (Dury coll.); 1 ♂, 1 ♀, State label, T. Pergande coll. (USNM); 1 ♂, 1 ♀, Valley Park, Apr. 1, 1920, H. R. Painter (USNM). NEBRASKA: 1 ♀, Chadron, May 15, 1955, Jellison (CNC); 1 ♀, Spencer, June 10, 1931, G. E. Hudson (USNM); 1 ♂, Superior, (Liebeck coll., MCZ); 1 ♂, State label, (ANSP); 1 ♂, War Bonnet Canyon (CNC). OHIO: 1 ♂, Champaign Co., Sept. 5, 1954, R. E. Woodruff (OSU). SOUTH DAKOTA: 1 ♂, Capa, May 11, 1922, H. C. Severin (USNM); 1 ♂, Chamberlain, Sept. 14, 1946, H. C. Severin (USNM); 1 ♀, Volga, Truman (USNM). NO DATA: 1 ♂, (Bowditch coll., MCZ); 1 ♀, O. Lugger coll. (CNHM).

REMARKS.—Variation in the specimens, here considered to be the subspecies *pseudorpheus*, is not as great as in the other forms. Males range from 5.8 to 9.0 mm. in length and from 3.4 to 5.1 mm. in width; females range from 6.0 to 8.0 mm. in length and from 3.6 to 4.8 mm. in width. The dorsal color varies from green or yellowish green to green with a coppery cast, but the coppery color is never as pronounced as in *canadensis* and is relatively rare, most of the specimens appearing green or yellowish green. There is some variation in the prominence of the tubercles and the size of the punctures. Even though faint, the the tubercles are always present and the pronotal punctures generally are large, distinct even basally, and usually separated by no more than 1 to 2 diameters. The dorsal setae vary slightly in length but are always erect and prominent. The clypeal carina in the male majors varies in degree of development, but the carina is always elevated, at least medially. In the females the frontal carina of the vertex is not as constant, usually being slightly lower medially, but with numerous exceptions.

Despite the variation, the subspecies *pseudorpheus* can be separated from the other forms of *orpheus* by its very distinct dorsal setae with usually distinctly tuberculate pronotum and elytra, by the medially elevated clypeal carina of the male majors, and by the medially slightly depressed frontal carina of the females. It can be separated from other species of *Onthophagus* by the specific characters listed under *orpheus orpheus* (p. 47).

Little is known about the subspecies *pseudorpheus*. In general it appears to be a prairie form unlike the other subspecies which are woodland forms. Only two specimens have been associated with any animals and these were taken from the nest of a mouse, *Microtus ochrogaster* (Wagner).

Onthophagus cynomysi Brown

PLATE 5, FIGURES 42 AND 43

Onthophagus cynomysi Brown, 1927, p. 131.—Boucomont, 1932, p. 311.—Leng and Mutchler, 1933, p. 38.—Howden, Cartwright, and Halffter, 1956, p. 11.

MALE MAJORS.—Length 6 to 10 mm., width 3.5 to 4.5 mm. Shining, piceous; head and thorax sometimes vaguely aeneous, legs brownish black, antenna brownish red, the club grayish brown. Head with clypeus strongly reflexed anteriorly, vaguely emarginate, discal surface rugosely punctate, with fine secondary punctures scattered among the coarse ones; vertex and prominent gena with a few scattered, coarse, setigerous punctures and a number of fine secondary punctures. Clypeal carina barely indicated, carina on vertex represented only laterally by a single short tubercle above and behind each eye.

Pronotum margined anteriorly and laterally; convex with anterior process extending over the head almost as far as the anterior edge of the clypeus, this process bifurcating over the vertex, the lateral extensions ending in outwardly flared, hatchet-shaped tips; the process narrowest near its base just behind the pronotal margin, but not flaring noticeably outward until the area of bifurcation, at which point the extensions curve outward and downward; viewed laterally the process curves evenly downward, almost touching the clypeus. Pronotal surface punctate-tuberculate; the pronotum with a tuberculate rather than a punctate appearance because each coarse thoracic puncture bears a pronounced tubercle at its anterior margin; the tubercle-punctures most numerous laterally and on the pronotal process, becoming more sparse and less pronounced medially and posteriorly; a few small secondary punctures, which lack tubercles, scattered over the discal area of the pronotum between the coarse punctures. Pronotum with a smooth, impunctate line more or less traceable forward in some specimens; midline widely, increasingly depressed posteriorly over basal fourth in all specimens. Elytra with well-defined striae; intervals, except for the sutural interval, irregularly, biserially tuberculate, with a minute seta-bearing puncture at the base of each tubercle; surface smooth and shining, not alutaceous.

Pygidium coarsely, setigerously punctate with scattered fine secondary punctures intermingled with the coarse punctures on the lower half. Ventral portions of thorax laterally alutaceous and coarsely setigerously punctate, metasternum medially having only fine secondary punctures and a faint longitudinal sulcus. Abdominal segments coarsely punctate laterally, finely so medially, the last segment emarginate medially. Foreleg with femur and tibia longer than in female, the distal end of the femur extending to the lateral margin of the thorax; tibia with four large lateral teeth with serrate margin between

and a conical apical tooth above the short inturned tibial spine, femora of mesothoracic and metathoracic legs having on their ventral surfaces scattered coarse setigerous punctures and a few very fine punctures.

MALE MINORS.—Length 7 to 8 mm., width 4.3 to 4.6 mm., usually smaller than male majors or females, differing from the former in the following respects: Clypeus reflexed only slightly more anteriorly than laterally, clypeal carina pronounced, transverse carina of the vertex complete, highest laterally, indicative of the conical tubercles above the eyes in male majors, the pronotal projection greatly reduced, only slightly bifurcate, fore femur and tibia not greatly elongate; tibia lacking the apical conical tooth over the elongate tibial spine which resembles that of a female.

FEMALES.—Length 9 to 10 mm., width 5 to 5.5 mm. Differing from the male major in the following respects: Clypeal margin rather evenly arcuate, slightly emarginate, moderately reflexed anteriorly, only slightly so laterally; surface very coarsely, rugosely punctured, much more so than males; carinae of both clypeus and vertex pronounced, that of vertex being more pronounced and highest medially; vertex before the carina slightly more coarsely punctured than in male and with scattered secondary punctures. Pronotum with the median process evidenced by a broad hump, most pronounced at the lateral angles, not extending beyond the anterior prothoracic margin. Elytra and pygidium similar to those of male. Prothoracic legs not elongate, the apical end of the femur not extending as far as the lateral margin of the thorax; tibia laterally with four large teeth, proportionately shortened and lacking the apical conical tooth; tibial spine long and curved inward at the tip. Mesothoracic and metathoracic femora slightly thicker and shorter than in male majors.

TYPE.—Canadian National Collection 2471.

TYPE LOCALITY.—101 Ranch, Noble Co., Okla.

SPECIMENS EXAMINED.—38.

DISTRIBUTION.—(See fig. 7, p. 59.)

OKLAHOMA: Noble Co., Stillwater, Grady Co., Cleveland. NEW MEXICO: Cloudcroft, Roswell.

REMARKS.—This species can be distinguished from *orpheus*, *pseudorpheus*, and other allied species of *Onthophagus* by its large size, piceous color, coarse setigerous punctures of the pronotum with definite tubercles at their anterior margins, presence of secondary pronotal punctures, elytral intervals (except for sutural ones) irregularly biserially tuberculate, and the quite distinctive secondary sexual characteristics of male majors.

O. cynomysi exhibits not only less morphological variability than does *orpheus* or *pseudorpheus*, but it is also quite restricted in its habitat

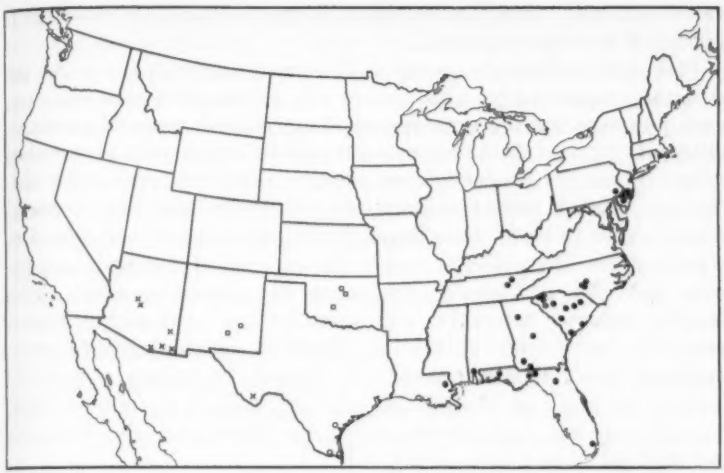

FIGURE 7. Distribution of species of *Onthophagus:*

● *concinnus* Laporte
X *browni*, new species
○ *schaefferi*, new species
□ *cynomysi* Brown

preference, being found only in the burrows of the common prairie dog, *Cynomys ludovicianus* (Ord).

Onthophagus subopacus Robinson

PLATE 5, FIGURES 40 AND 41

Onthophagus subopacus Robinson, 1940, p. 142.—Blackwelder and Blackwelder, 1948, p. 30.

Onthophagus lecontei Schaeffer, 1914, p. 298 (not Harold, 1871, p. 115).—Leng, 1920, p. 249.—Boucomont, 1932, p. 327 (in part).—Blackwelder and Blackwelder, 1948, p. 30

MALE MAJORS.—Length 4.4 to 5.7 mm., width 2.6 to 3.3 mm. Black, finely alutaceous, opaque. Clypeus anteriorly sharply reflexed, distinctly emarginate; surface dully shining, very coarsely, rugosely punctate laterally with one or two punctures medially; clypeal carina vague or completely lacking; surface of frons and vertex finely alutaceous with scattered coarse punctures, each bearing a long reddish seta. Gena delimited from the clypeus by a suture extending from distinct marginal notch posteriorly to the lateral base of the transverse carina of the vertex; laterally slightly flared, then parallel-sided, and finally slightly arcuate inward to the eye. Carina of the vertex may or may not be pronounced, but is distinctly evident, of uniform height its entire length, and extends approximately three-fifths of the distance between the eyes. Robinson stated this

carina was only vaguely indicated in his specimens, but in some specimens it is quite pronounced.

Pronotum moderately convex, rather evenly, coarsely punctate; the punctures separated by a distance of 1 to 3 times their own diameter, each puncture bearing a moderately long, reddish seta and overhung anteriorly by a small shining tubercle; the tubercles quite pronounced anteriorly on the pronotal hump; surface otherwise very finely alutaceous. Entire pronotum poorly but distinctly margined; pronotal protuberance in its greatest development extending over the head to a point above the posterior carina, its anterior edge slightly emarginate and with a bilobate appearance, the lateral rounded angles slightly reflexed anteriorly; the protuberance gradually narrowed anteriorly, being widest at its base. Elytral striae shining and vaguely punctate; the intervals (except the sutural) irregularly, biseriately tuberculate, the base of each tubercle with a small puncture bearing a moderately long, reddish seta, the surface between finely alutaceous and with an opaque appearance.

Pygidium very coarsely punctate throughout, each puncture bearing a fine reddish seta; basal half of pygidium finely alutaceous, apical half becoming smooth and shiny. Ventral surfaces brownish black to black, antennal club varying from yellowish brown to black. Metasternum, except in the vaguely depressed median line, with large, coarse punctures, each puncture bearing a long, reddish seta; surface alutaceous between the lateral punctures. Abdominal segments, excluding the first, each with a row of long, reddish setae along their basal edge arising from large, rather poorly defined punctures; the remaining surface of abdomen shiny but finely alutaceous; last abdominal segment emarginate, being narrowed near the median line. The long, conspicuous setae of the thorax and abdomen are quite characteristic. Anterior tibiae long, slender, and arcuate anteriorly, the outer margin crenate above and between the four teeth; apex of tibia with a pencil of yellowish hairs. Middle and hind legs not greatly elongate; surface of the femora with a few scattered, coarse punctures, each bearing a long reddish seta.

Male minors.—Length 4.4 mm., width 2.6 mm. Differing from the male majors in the following respects: Clypeal carina vaguely indicated; carina of vertex pronounced, not vague as it often is in male majors; pronotal protuberance small, evenly rounded, without any emargination; foretibiae not greatly elongate but still slender; pencil of hairs scarcely indicated; in other respects similar to male majors.

Females.—Length 4.8 to 5.3 mm., width 3.1 to 3.3 mm. Clypeus with anterior edge poorly reflexed and distinctly emarginate; surface coarsely, densely punctured, somewhat rugose and shining, densely punctured. Clypeal carina distinct, highest medially; carina of vertex

slightly shorter, but well delimited and pronounced. Frons and vertex alutaceous, with a few scattered medium punctures. Pronotum similar to that of male except that the pronotal protuberances are represented by a short arcuate line on each side of midline; elytra similar to those of male. Pygidium a little more shining than in the male. Anterior tibiae thickened and short, nearly straight, crenate above and between the four teeth and lacking the apical pencil of hairs. Last abdominal segment only very slightly narrowed medially, not greatly narrowed as in the male.

TYPE.—USNM 65680.

TYPE LOCALITY.—Prescott, Yavapai Co., Ariz.

SPECIMENS EXAMINED.—29.

DISTRIBUTION.—(See fig. 3, p. 24.)

ARIZONA: Baboquivari Mts., Chiricahua Mts., Payson, Phoenix, Prescott, Sierra Ancha Mts. (Gila Co.), Southwestern Research Station, 5 mi. west of Portal.

REMARKS.—This species is distinguished from the closely allied Mexican species *O. lecontei* Harold by its more shining clypeus and pygidium and by the lack of a definite clypeal carina in the male major. In addition, the range, as far as known, does not overlap, *O. subopacus* being known only from the higher elevations of southeastern Arizona. Howden collected a few specimens by scraping away the ground cover in an area in which cattle and deer had been feeding near Onion Saddle in the Chiricahua Mountains, but none of the specimens taken were associated with animal droppings. L. J. Bottimer trapped some specimens in malt bait cans at the Southwestern Research Station near Portal. This species previously has been incorrectly recorded as *lecontei*, a species known only from Mexico.

Onthophagus subopacus may be separated from other North American species by the finely alutaceous surface; the coarsely punctured pronotum, each puncture overhung anteriorly by a small tubercle with a conspicuous reddish seta at its base; the shining elytral striae; the biseriately tuberculate intervals, with the tubercles having reddish setae at their bases; the dorsal opaque black color; the brownish black legs; and the lack of the clypeal carina in the males.

Onthophagus monticolus, new species

PLATE 5, FIGURES 38 AND 39

HOLOTYPE.—Male major, length 6.2 mm., with 3.7 mm. Weakly shinning, opaque black. Clypeal margin sharply reflexed anteriorly, feebly so laterally, anterior edge faintly emarginate; clypeal disc with a few coarse punctures scattered completely across its width. Frons with scattered shallow punctures which are much more noticeable

than in males of either *O. alluvius* or *O. knulli*. Clypeal disc and frons almost flat and lacking both clypeal and frontal carinae, the latter being poorly indicated behind eyes; surface between punctures finely alutaceous. Margin of gena noticeably arcuate laterally, anteriorly forming a distinct, obtuse indentation with the clypeal margin; gena sharply, obtusely angulate posteriorly opposite the pronotal angles; surface of gena slightly concave and with scattered coarse punctures.

Pronotum moderately convex, margined anteriorly and laterally; pronotal protuberance a conical median hump, barely projecting over the posterior portion of the head. Surface distinctly alutaceous and with punctures of two sizes: larger punctures annular with margins sharply defined, centrally with an erect reddish-yellow seta, the large punctures usually separated by about two diameters; small secondary punctures half the diameter of large punctures and nearly as numerous, scattered among large punctures; small punctures with sharply delimited margins and lacking central seta. Elytra with feebly shining, vaguely punctate striae; intervals opaquely alutaceous with irregular double rows of small shining tubercles; the base of each tubercle with a fine reddish-yellow seta.

Pygidium with very shallow, coarse, setigerous punctures scattered evenly over surface; entire pygidium except extreme apex opaquely alutaceous; evenly, only slightly convex. All ventral surfaces black except for antennae, tibiae, and tarsi which are tinged with brown. Ventral surfaces of metasternum coarsely punctured, more so laterally; lateral surface between punctures finely alutaceous. Metasternum near midline with a few large punctures and numerous fine ones (metasternum distinctly more punctate near midline than in Texas specimens of *knulli*); midline posteriorly vaguely indented. Ventral segments of abdomen and legs not differing noticeably from those described for holotype of *O. alluvius*, except that the punctures on the femora are larger and more numerous than is usual for *alluvius*.

MALE MINOR.—Paratype, length 4.3 mm., width 2.6 mm. Differing from the holotype male major in the following respects: Clypeus much less sharply reflexed, distinctly emarginate; surface rather evenly, coarsely, rugosely punctate. Clypeal carina lacking; frontal carina low but distinct, slightly indented medially. Gena not greatly produced but still angulate near pronotal angle. Pronotum less convex; pronotal protuberance obsolete, very faintly indicated by a slightly less alutaceous area; pronotal punctures similar but shallower and more widely spaced than in holotype (or other male majors). Elytra and pygidium similar to male majors except that pygidium is alutaceous to apex. Ventral surfaces brownish black, slightly more heavily punctate. Forelegs greatly shortened, the forefemur barely extending to the lateral pronotal margin and the foretibia propor-

tionately shortened and somewhat thickened; both apical conical projection and distinct pencil of hairs lacking.

ALLOTYPE.—Female, length 5.9 mm., width 3.6 mm. Differing from the holotype male major in the following respects: Clypeus slightly reflexed anteriorly, broadly, somewhat angularly emarginate; clypeal disc coarsely, rugosely punctate, the punctures often with brownish-yellow setae; clypeal carina distinct but only slightly, rather evenly, elevated above clypeal-frontal surface. Frons behind carina coarsely punctate; frontal carina low but distinct, generally of uniform height, vaguely indented medially, becoming gradually obsolete laterally; gena scarcely flared, only very obtusely angulate near pronotal angle.

Pronotum less convex, pronotal protuberance indicated by a vague rounded swelling; punctures about the same sizes and density as on the male majors. Elytra and pygidium generally similar to male majors. Ventral surfaces similar to male major except for shortened stubby forelegs; the apex of forefemur barely reaching the lateral pronotal margin; foretibia proportionately shortened; apical projection and pencil of hairs lacking; apical spine as long as the three basal tarsal segments. Last abdominal segment not emarginate, approximately the same width throughout.

TYPE.—Canadian National Collection 7529.

TYPE LOCALITY.—Chipinque Mesa (5400 ft.) near Monterrey, Nuevo León, Mexico.

SPECIMENS EXAMINED.—67.

DISTRIBUTION.—(See fig. 8, p. 64.) Holotype, ♂, and allotype, ♀, Chipinque Mesa (5400 ft.) near Monterrey, Neuvo León, Mexico, Aug. 26–29,1960, on cow dung, H. F. Howden. And the following paratypes:

MEXICO: NUEVO LEÓN: 24 ♂♂, 24 ♀♀, same data as type (CNC, USNM, Howden). PUEBLA: 7 ♂♂, 8 ♀♀, 6 mi. west of Teziutlán, Aug. 19, 1958, in human dung, H. F. Howden (CNC, USNM).

UNITED STATES: TEXAS: 1 ♂, Boot Springs, Chisos Mts., Big Bend National Pk., 7000 ft, May 18, 1959, in horse dung, H. Howden and E. Becker (CNC).

REMARKS.—As is usual in *Onthophagus*, size range in the species is considerable. Males vary from 4.3 to 6.9 mm. in length and from 2.6 to 3.9 mm. in width. Females vary from 5.2 to 6.5 mm. in length and from 3.2 to 4.0 mm. in width. Specimens are nearly always black, but unworn or teneral specimens have a brownish cast. There is some variation in the size, depth, and spacing of the pronotal punctures. In some specimens the large setigerous punctures are relatively close, being separated by a distance equal to 1 to 2 diameters; in others, from the same locality, the punctures may be separated by a distance equal to 4 to 5 diameters. The margin of the pronotal punctures is usually distinctly depressed, but not infrequently the outer part of the puncture is represented by a shining ring scarcely, if at all, depressed.

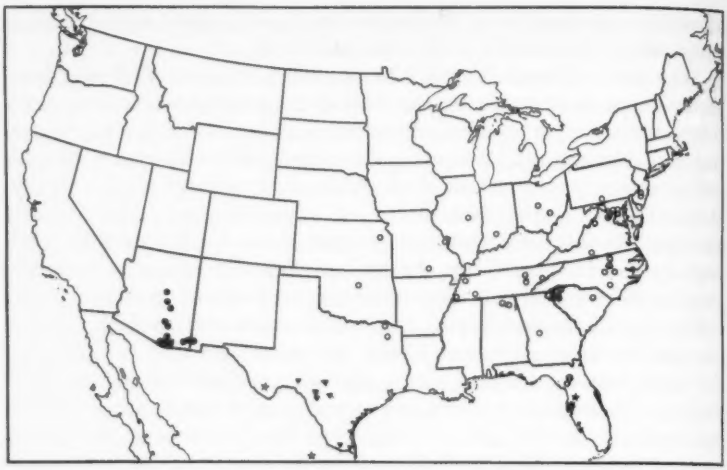

FIGURE 8. Distribution of species of *Onthophagus:*

● *knulli*, new species
▼ *alluvius*, new species
☆ *monticolus*, new species
○ *subaeneus* (Palisot de Beauvois)
★ *aciculatulus* Blatchley

Secondary punctures likewise are occasionally relatively scarce, but this apparent scarcity may be due to abrasion.

Only specimens from the Chisos Mountains of Texas and from the eastern escarpment of the Sierra Madre Oriental in Mexico are included under this species at present. We have examined a Champion specimen, a female, collected at 7800 ft. at Quezaltenango, Guatemala; though very close to *O. monticolus*, the specimen shows some slight differences in the pronotal punctures and the pygidium is quite convex. This Guatemalan form is almost certainly the one called *O. anthracinus* Harold by Bates (1887, p. 77). Even if conspecific with *monticolus* (assuming it is the *anthracinus* of Harold and not referable to *alluvius*), the name *monticolus* will be valid. However, it appears likely that the two forms are not conspecific. More material is needed before the matter can be settled.

O. monticolus can be distinguished by its black color, its well-separated, distinctly margined, often annular setigerous prontal punctures, small nonsetigerous secondary punctures, pronotal surface dull and alutaceous between punctures, median pronotal protuberance always at least vaguely indicated, and by its tuberculate alutaceous elytra. The pronotal punctures, though quite similar to those of *O. knausi* Brown, are separated by more than 1 diameter; the pronotal surface between the punctures in *knausi* is shining and only minutely

alutaceous, but in *monticolus* is dull. The largely alutaceous, very feebly convex pygidium will separate *monticolus* from *alluvius* or *knulli*.

The adult habits of *monticolus* appear to be nearly identical with those of *alluvius* and *knulli*. All the specimens were taken at elevations over 5000 ft. in mixed deciduous-pine forests. Specimens were taken on cow and horse dung and in human feces. On the Chipinque Mesa near Monterrey, *monticolus* and *alluvius* were taken together in the same pile of dung, this being the only locality where both species were found together. Normally, *O. monticolus* seems to inhabit high elevations with moist cool climate; *alluvius* is largely a lowland form, surviving under hotter, dryer conditions.

Onthophagus alluvius, new species [4]

PLATE 5, FIGURES 36 AND 37

Onthophagus anthracinus Harold, 1873, p. 104 (not Falderman, 1835, p. 247).—Bates, 1887, p. 77.—Schaeffer, 1905, p. 157; 1909, p. 382; 1914, p. 298.—Leng, 1920, p. 249.—Dawson, 1922, p. 179 (misdetermination for *knausi*—fide Brown, in personal communication.).—Boucomont and Gillet, 1927, p. 204.—Boucomont, 1932, p. 312.—Lindquist, 1935, p. 7.

HOLOTYPE.—Male major, length 5.8 mm., width 3.4 mm. Weakly shining, opaque black, the elytra with a faint brownish cast. Clypeus sharply reflexed; anteriorly, very feebly, shallowly emarginate. Clypeal disc and frons almost flat and lacking both clypeal and frontal carinae; the frontal carina represented by a small ridge behind each eye; surface very finely alutaceous with scattered fine punctures; scattered coarse punctures present only laterally on clypeus. Edge of gena noticeably arcuate laterally, with its anterior margin forming an obtuse indentation with the clypeal margin, separated from the clypeus by a fine suture; surface of gena with a few scattered coarse punctures. Pronotum moderately convex, margined anteriorly and laterally; pronotal protuberance a slightly flattened cone-shaped median hump, barely projecting over the posterior portion of the head; pronotal surface alutaceous and rather evenly, coarsely punctate; punctures not distinctly annular, separated by approximately 2 to 3 times their diameter, and bearing fine, moderately long setae about half again as long as the distance between punctures; small secondary punctures lacking over most of disc. Elytral striae shining, vaguely punctate; intervals opaquely alutaceous with irregular double rows of small shining tubercles, the base of each tubercle

[4] *O. alluvius* is described as a new species inasmuch as there is some doubt whether the United States form is conspecific with the form from Guatemala (type locality of *anthracinus* Harold). If the two can be conspecific, *alluvius* will still be the valid name of the species, the name *anthracinus* being preoccupied and no other name being available; the same statement applies if *anthracinus* Harold is conspecific with the closely allied *monticolus*. It seems likely that Bates (1877, p. 77) in his description referred to *monticolus* or a closely allied form.

with a reddish-yellow seta. Pygidium coarsely punctate, the punctures poorly defined basally; basal half altaceous, apical half shining and very convex. Pygidium, abdomen, mesosternum, and metasternum black, prosternum and legs reddish black. Antennal club grayish, tinged with brown. Ventral surfaces of thorax, particularly the metasternum, coarsely punctured, more so laterally than medially, each puncture usually bearing a reddish seta; surface laterally between punctures finely alutaceous; metasternum smoothly shining medially, not indented, posteriorly impunctate except for one or two punctures. Abdominal segments, except first, with a row of setigerous punctures across their base; last segment narrowed medially, emarginate as is typical of genus. Forelegs greatly elongated, the apices of the forefemora extending slightly beyond the pronotal margin; foretibiae proportionately as long, slender, and recurved, with a pronounced projection and a long yellowish pencil of hairs protruding above the apical spine; femora of middle and hind legs with scattered coarse punctures, each puncture bearing a reddish seta.

MALE MINOR.—Paratype, length 5.1 mm., width 2.9 mm. Differing from holotype male major in following respects: Clypeus less sharply reflexed anteriorly, noticeably emarginate, surface coarsely punctate laterally, somewhat rugose; frons with a few coarse punctures and scattered fine ones, somewhat alutaceous; clypeal carina lacking, frontal carina quite pronounced, of rather uniform height, and sharply terminated laterally; gena not as noticeably produced laterally as in male major, but still well-delimited from clypeus.

Pronotum less convex but similar to male major except for pronotal protuberance, which is almost entirely lacking but indicated by a broad, arcuate median line that scarcely protrudes medially over the anterior pronotal margin; reddish-yellow setae present in almost all the pronotal punctures. Elytra and pygidium as described for male major. Ventral surfaces similar to male major. The legs reddish brown with the forelegs greatly shortened, the forefemur barely extending to the lateral pronotal margin and the foretibia proportionately shortened and somewhat thickened; both the conical projection and the yellow pencil of hairs over the apical tibial spine missing.

ALLOTYPE.—Female, length 6.3 mm., width 3.6 mm. Differing from male major in following respects: Clypeus slightly reflexed anteriorly; broadly, somewhat angularly emarginate. Clypeal disc coarsely rugosely punctate, the punctures often with yellowish setae; clypeal carina low, weak but distinct, highest medially; scattered coarse setigerous punctures behind clypeal carina. Frontal carina pronounced, almost twice as high as the clypeal carina, medially of uniform height, laterally becoming gradually obsolete. Gena only slightly flared and broadly arcuate.

Pronotum almost exactly the same as described for the male minor, the arcuate protuberance being slightly more pronounced, but otherwise similar. Elytra as described for male major. Pygidium similar to holotype but with the apex slightly less convex than in male. Ventral surfaces similar to male minor with following exceptions: Forelegs shortened and stubby; apex of forefemur not extending to lateral pronotal margin; foretibia proportionately shortened and thickened, apical spine slender, as long as 2½ tarsal segments and gradually recurved. Last abdominal segment not emarginate at middle.

TYPE.—Canadian National Collection 7527.

TYPE LOCALITY.—Bentsen-Rio Grande State Pk., near Mission, Tex.

SPECIMENS EXAMINED.—281.

DISTRIBUTION.—(See fig. 8, p. 64.) Holotype, ♂, and allotype, ♀, Bentsen-Rio Grande State Pk., near Mission, Tex., June 4, 1954, in dung. H. F. Howden. And the following paratypes:

TEXAS: 12 ♂♂, 14 ♀♀, same data as type (CNC, AMNH, Howden); 5 ♂♂, 6 ♀♀, reared from pair from type locality (Howden); 8 ♂♂, 7 ♀♀, type locality, Sept. 28, 1951, O. L. Cartwright and A. B. Gurney (USNM); 1 ♂, 2 ♀♀, Brownsville, May 10 (CNC, OSU); 1 ♀, Brownsville, Apr. 12–May 20 (CNC); 2 ♂♂, Brownsville, Nov. 21, 1911, palm jungle, human dung (CNC); 1 ♀, Brownsville, Feb. 7, 1948, L. J. Bottimer (LJB); 4 ♂♂, 6 ♀♀, Brownsville, Esperanza ranch, May 1–29 (USNM, AMNH); 2 ♀♀, Brownsville, June 1901 (Schaeffer coll., USNM); 1 ♀, Brownsville, July 30, 1906, A. B. Wolcott (CNHM); 1 ♂, Cameron Co. (USNM); 7 ♂♂, 3 ♀♀, Camp Stanley, Bexar Co., Apr. 2, 1953, in horse dung, L. J. Bottimer (USNM); 1 ♂, 1 ♀, Devils River, May 5, 1907, F. C. Bishopp (USNM); 8 ♀♀, 25 ♀♀, Garner State Pk., Sept. 22, 1951, in cow dung, O. L. Cartwright and L. J. Bottimer (USNM, LJB); 70 ♂♂, 57 ♀♀, Kerrville, June 25, 1956, cow dung, L. J. Bottimer (USNM, LJB); 9 ♂♂, 15 ♀♀, Kerrville, July 22, 1956, in deer dung, H. and A. Howden (Howden); 5 ♂♂, 7 ♀♀, Kerrville, Apr. 4, 1959, Becker and Howden (CNC); 1 ♂, Kerrville, May 5, 1955, in flight, L. J. Bottimer (LJB); 1 ♂, Kerrville, Apr. 10, 1951, deer droppings, L. J. Bottimer (LJB); 1 ♀, Kerrville, Sept. 20, 1951, horse dung, L. J. Bottimer (LJB); 1 ♀, Kerrville, July 30, 1948, dead on carass, L. J. Bottimer (LJB); 1 ♂, Kerrville, May 23, 1947, L. J. Bottimer (LJB); 1 ♂, Macdona, July 28, H. A. Wenzel (OSU); 2 ♂♂, 4 ♀♀, Mission, Oct. 1, 1951, O. L. Cartwright (USNM); 1 ♀, San Antonio, Sept. 24, 1951, O. L. Cartwright and A. B. Gurney (USNM); 2 ♂♂, 1 ♀, southwest Hidalgo Co., Jan. 26, 1947, at raccoon(?) dung, G. B. Vogt (Vogt); 1 ♂, 1 ♀, Uvalde, June 30, 1936, J. N. Knull, (OSU, USNM); 11 ♂♂, 7 ♀♀, Uvalde, Dec. 1920, J. C. Bridwell (USNM); 3 ♂♂, 2 ♀♀, Uvalde, May 29, July 18, 22, 29, August, 1932, A. W. Lindquist (USNM, CNC); 1 ♂, Uvalde Co., May 20, 1938, J. H. Robinson (Howden).

MEXICO: SAN LUIS POTOSÍ: 1 ♀, Valles, Aug. 29, 1936, E. D. Ball (UA). NUEVO LEÓN: 7 ♂♂, 12 ♀♀, Chipinque Mesa (5400 ft.) near Monterrey, Aug. 26–29, 1960, H. F. Howden (CNC); 1 ♂, 7 ♀♀, 2 mi. west of Linares, Nov. 8, 1946, E. S. Ross (CAS); 2 ♂♂, 3 ♀♀, Monterrey, July 24, 1960, cow dung, H. F. Howden (CNC). TAMAULIPAS: 14 ♂♂, 5 ♀♀, crest of first ridge west of Antiquo Morelos, Nov. 18, 1948, H. B. Leech (CAS, Howden); 1 ♀, 47 km. south of Ciudad Victoria, July 5, 1948, W. Nutting (USNM); 1 ♀, 20 mi. north of El Limón, Nov. 10, 1946, Ross (Howden).

REMARKS.—Variation in the series available occurs mainly in size. Males vary from 4.5 to 7.1 mm. in length and from 2.9 to 3.9 mm. in width; females vary from 4.8 to 6.8 mm. in length and from 2.9 to 3.8 mm. in width. Color also shows some variation, for though the majority of specimens are black, a few specimens are distinctly brownish (teneral); rarely specimens have the elytral umbones and apices spotted light brown. Pronotal punctures vary somewhat in density and occasionally appear faintly annulate. However, the margin of the puncture is normally not distinct, and small nonsetigerous secondary punctures are rare.

O. alluvius is closely related to *O. knulli* and *O. monticolus*. It can be distinguished from the allopatric *knulli* by its nearly impunctate posterior median portion of the metasternum and by its more convex pygidium. In addition, *O. alluvius* averages larger in size (about 5 to 6 mm.), is usually a more shining black, and has less obvious dorsal setae than does *knulli*. *O. alluvius* can be distinguished from the partially sympatric *monticolus* by the general lack of small secondary punctures on the pronotum and by the punctate shining, distinctly convex apex of the pygidium. *O. alluvius* can be separated from other species of *Onthophagus* by the dully shining black color, the well-separated pronotal punctures, the median pronotal protuberance which is at least vaguely evident in both males and females, and the elytral intervals with their two irregular rows of small tubercles and alutaceous surface.

For some time during the course of this revision we considered *O. alluvius* and *O. knulli* one species. Small specimens of *alluvius* have the more pronounced dorsal setae that are usual in *knulli* (which is always smaller). The relative rarity of well-developed males in *knulli* perhaps indicates survival under marginal conditions. However, as more and more material was accumulated during the course of this work, a constant morphological difference in the metasternum became apparent; this difference coupled with the lesser differences in the pygidium, the average size-difference, and the allopatric distribution made us conclude that two species are represented. *O. alluvius* is apparently largely limited to the lowland regions of eastern Texas and eastern Mexico, being particularly common in alluvial areas; *knulli* occurs in the mountainous regions of southern Arizona.

The habits of *O. alluvius* seem to be quite similar to those of *O. texanus*. Specimens were most frequently found in cow dung in wooded areas.

Lindquist (1935, p. 7) stated (under the name *anthracinus*) that Texas specimens—

> * * * are found in dung from March to December, and a hundred or more have been counted in a single dropping. A burrow is dug vertically into ground

to a depth of 1 to 4 inches and dung is transported into the lower extremity, where it is fashioned into a crude ball in which an egg is laid.

Reared females have deposited from 43 to 67 eggs over periods of 22 to 42 days. Only 1 or 2 eggs are laid daily, and these average 1.56 by 0.74 mm. in diameter. The average developmental period from egg to adult in summer was 38.4 days, with a range of 36 to 52 days. Notes on the number of instars are not complete, but indications are that there are three.

Specimens of *O. alluvius* collected near Brownsville, Tex., brought back to Knoxville, Tenn., and reared in soil-filled flower pots, followed closely the pattern described by Lindquist. The adults made shallow 1- to 8-inch burrows around and under fresh cow droppings. The brood cells averaged 12 mm. in length by 7 mm. in width and contained a cavity in their upper end in which the elongate whitish egg was laid. Each female formed 20 to 40 cells, the number limited perhaps by crowding. Development was very rapid, each of the 3 instars lasting 7 to 9 days with a pupal period of 5 to 7 days. Total developmental time in the flower pots was 35 to 36 days, approximately the developmental time as given by Lindquist.

Onthophagus knulli, new species

PLATE 5, FIGURES 34 AND 35

Onthophagus anthracinus Harold 1873, p. 104 (not Falderman, 1835, p. 247).—Schaeffer, 1905, p. 157; 1914, p. 298 (in part).—Leng 1920, p. 249 (in part).

HOLOTYPE.—Male major, length 5.1 mm., width 3.2 mm. Opaque black, with a slight brownish cast on head and pronotum. Clypeal margin sharply reflexed anteriorly only, edge faintly emarginate; clypeal disc and frons nearly flat, a few coarse punctures near their lateral edges; posterior portion of clypeus and remainder of head distinctly alutaceous, minute secondary punctures present; all carinae absent except for slight ridges behind eyes; genae not greatly expanded, edges arcuate, anteriorly forming a very oblique indentation with clypeal edges.

Pronotum moderately convex; punctures, setae, margins, and protuberance nearly identical to that of male major of *O. alluvius*. The setae slightly more pronounced, punctures very slightly closer, and surface between somewhat more alutaceous; small secondary punctures largely lacking and the large punctures not distinctly annular. Elytra with feebly shining, very vaguely punctate striae; intervals opaquely alutaceous with somewhat irregular, double rows of small shining tubercles, the base of each tubercle with a fine reddish-yellow seta. The rows of tubercles are much more regular and the tubercles are more numerous than in either *alluvius* or *monticolus*.

Pygidium alutaceous basally, shining apically, apical half slightly convex and distinctly, deeply punctate. Ventral surfaces shining

black to brownish black, antennal club grayish brown. Metasternum as coarsely punctured near midline as laterally; narrow band at midline impunctate and faintly indented posteriorly. The metasternal punctures medially larger and twice as numerous as in *alluvius*, and slightly larger and more numerous than in *monticola*. Ventral segments of abdomen and legs not differing noticeably from those described for the holotype of *alluvius*.

MALE MINOR.—Paratype, length 4.1 mm.; width 2.6 mm. Differing from the holotype male major in the following respects: Clypeus shallowly reflexed anteriorly, less so laterally, somewhat more distinctly emarginate; clypeal disc and frons with more numerous, evenly distributed, coarse, setigerous punctures; clypeal carina lacking; frontal carina low but distinct, very slightly indented medially; gena scarcely produced, edge arcuate. Pronotum less convex, pronotal protuberance obsolete, indicated by a faint bulge in the median convexity of the pronotum; punctures somewhat more distinctly margined and more closely spaced. Elytra with rows of tubercles on elytra somewhat more irregular, the tubercles still more numerous than in *alluvius* or *monticolus*. Ventral surfaces similar to type but slightly more heavily punctate on metasternum. Forelegs greatly shortened, the forefemora barely extending to the lateral pronotal margin and the foretibia proportionately shortened and somewhat thickened; both apical conical projection and distinct pencil of hairs lacking.

ALLOTYPE.—Female, length 4.5 mm., width 2.7 mm. Differing from the holotype male major in the following respects: Clypeus shallowly reflexed anteriorly and laterally, somewhat angularly emarginate anteriorly; clypeal disc closely, coarsely, rugosely, setigerously punctate; clypeal carina distinct but only slightly, rather evenly elevated above clypeal-frontal surface; frons behind carina with scattered coarse and fine punctures; frontal carina low but distinct, generally of uniform height, not indented medially, rounded off laterally to surface of vertex; gena scarcely flared, lateral edge arcuate.

Pronotum less convex, pronotal protuberance vaguely indicated by a rounded swelling; size and density of punctures similar to those of the male minor. Elytral intervals with double row of tubercles very irregular; number of tubercles noticeably fewer when compared to either male major or minor. Pygidium and ventral surfaces similar to male major except for shortened, stubby forelegs; the apex of forefemur barely reaching to the lateral pronotal margin; foretibia proportionately shortened, apical projection and pencil of hairs lacking, apical spine as long as the three basal tarsal segments. Last abdominal segment not emarginate at middle.

TYPE.—Canadian National Collection 7528.

TYPE LOCALITY.—5 mi. west of Portal, Ariz. (on the grounds of the Southwestern Research Station of the American Museum).

SPECIMENS EXAMINED.—210.

DISTRIBUTION.—(See fig. 8, p. 64.) Holotype, ♂, Southwestern Research Station, Portal, Ariz., Sept. 1, 1960, on carrion, H. F. Howden. Allotype ♀, same data as type except collected on Sept. 7, 1960 (CNC). And the following paratypes:

ARIZONA: 6 ♂♂, 2♀♀, same data as type or allotype (CNC); 1 ♀, Portal, Sept. 13, 1957, W. Rosenberg (WR); 2♀♀, 5 mi. from Portal, Sept. 31, 1957, W. Rosenberg (WR); 1 ♀, Southwestern Research Station, Portal, July 7, 1961, B. Benesh (BB); 4 ♀♀, Southwestern Research Station, July 30, 1961, deer droppings, L. J. Bottimer (LJB); 1 ♂, 2 ♀♀, Southwestern Research Station, Aug. 2, 1961, cow dung, L. J. Bottimer (LJB); 3 ♂♂, 5 ♀♀, Southwestern Research Station, Aug. 4, 1961, cow dung, L. J. Bottimer (LJB); 2 ♂♂, base of Pinal Mts., June 19, July 12, 1925, D. K. Duncan (USNM, Duncan); 1 ♂, 1 ♀, Canelo, July 10, 1957, Aug. 3, 1956, G. D. Butler (UA); 3 ♂♂, Chiricahua Mts., D. K. Duncan (CAS, USNM); 5 ♂♂, 6 ♀♀, Chiricahua Mts., July 15, 17, 29, 30, 1959, D. J. and J. N. Knull (OSU); 10 ♂♂, 13 ♀♀, Duquesne, Sept. 27, 1956, L. J. Bottimer (LJB); 1 ♂, 1 ♀, Globe (USNM, CNC); 1 ♂, 3 ♀♀, Huachuca Mts. (Cochise Co.), July 12, August 1905 (CNC, USNM); 1 ♂, 2 ♀♀, Huachuca Mts., July 25, 1905 (Schaeffer coll. USNM); 1 ♂, Huachuca Mts., July 1936, E. S. Ross (CAS); 2 ♀♀, Huachuca Mts., Aug. 19, 1950, D. J. and J. N. Knull (OSU); 3 ♂♂, 3 ♀♀, Huachuca Mts., Sept. 11, 1928, E. R. Leach (Carnegie); 9 ♂♂, 17 ♀♀, Huachuca Mts., Sept. 11, 1928, Nunenmacher (CNHM, Howden); 1 ♀, Huachuca Mts., floor of Carr Canyon (5400 ft.), Aug. 7, 1952, Leech and Green (Howden); 2 ♂♂, Madera Canyon, Santa Rita Mts., Sept. 27, 1952, Norman Lewis (Edwards); 1 ♂, 1 ♀, Nogales, Santa Cruz Co., Aug. 17, 1906, F. W. Nunenmacher (CAS, USNM); 1 ♂, 1 ♀, Nogales (6000 ft.), Mt. Washington, July 11, 16, 1919, J. A. Kusche (CAS); 9 ♂♂, 5 ♀♀, Oracle, July 1, 2, 1936, E. S. Ross (CAS, Howden); 1 ♀, Oracle, June 30, 1936, M. Cazier (AMNH); 1 ♀, 14 mi. east of Oracle, July 25, 1924, J. O. Martin (CAS); 1 ♂, Palmerlee, Miller Canyon, July 21, 1907, H. A. Kaeber (CNC); 6 ♂♂, 10 ♀♀, Palmerlee, July 1, 10, 11, 12, 16, 21, 27, Plains, H. A. Wenzel (OSU, USNM, Howden); 3 ♂♂, 1 ♀, Patagonia, Aug. 21, 1940 (USNM); 1 ♂, Patagonia, Sept. 17, 1952, B. Malkin (Malkin); 1 ♂, Patagonia, July 10, 1936, E. S. Ross (CAS); 1 ♂, Patagonia, Aug. 2, 1924, J. O. Martin (CAS); 3 ♂♂, 2 ♀♀, Patagonia, July 6, 1936, Dazier (AMNH); 4 ♂♂, 4 ♀♀, Patagonia, July 21, 1940, F. W. Nunenmacher (CNHM); 1 ♂, Payson, August 1930 (Saylor coll., (CAS); 1 ♂, Pepper Sauce Canyon, Santa Catalina Mts., Aug. 14, 1940, E. S. Ross (CAS); 3 ♂♂, Pepper Sauce Canyon, Santa Catalina Mts., Aug. 17, 1924, J. O. Martin (CAS); 1 ♂, Pinal Mts., Gila Co., July 12, 1925, D. K. Duncan (USNM); 1 ♂, Prescott (Schaeffer coll., USNM); 2 ♂♂, 2 ♀♀, Ramsey Canyon, Huachuca Mts., W. H. Mann (USNM); 9 ♂♂, 5 ♀♀, Sierra Ancha Mts., Gila Co., August–September 1930, Duncan (CAS, CNC, USNM, Duncan, Parker); 2 ♂♂, 1 ♀, Southwestern Research Station, Portal, June 29, July 1, 10, 1956, on carrion, H. and A. Howden (Howden); 1 ♂, Southwestern Research Station, Portal, reared to adult on Aug. 2, 1956, on cow dung, H. and A. Howden (Howden); 1 ♂, Sycamore Canyon, Ruby, Sept. 26, 1953, G. D. Butler (UA); 1 ♂, Yanks Spring, 4 mi. southeast of Ruby, Pajaritos Mts., Santa Cruz Co. (4000 ft.), Sept. 5, 1950, Gertsch and Cazier (AMNH). NEW MEXICO: 1 ♂, 3 ♀♀, Rodeo, Sept. 2, 1957, W. Rosenberg (WR).

REMARKS.—Variation in *O. knulli*, as in *O. alluvius*, occurs mostly in size and color. Males vary from 4.0 to 5.5 mm. in length and from 2.5 to 3.2 mm. in width; females vary from 3.4 to 5.9 mm. in length and from 2.3 to 3.3 mm. in width. Color ranges from a dull black, with an indistinct brownish cast, to a dark brown. Not infrequently the elytral umbone and often the elytral apices are somewhat lighter in color, so that rarely the elytra have a vague spotted appearance. Some variation occurs in the density of punctures and elytral tubercles, but no great variation was noted. Pronotal punctures are usually vaguely ringed, but frequently the outer margin is obscure and the punctures are in these cases identical to those of *alluvius*.

Onthophagus knulli is very closely related to *alluvius* and slightly less so to *monticolus*. The large distinct punctures near the posterior midline of the metasternum readily distinguish *knulli*, and the small size which averages between 4 and 5 mm. is normally less than either of the related species. The lack of nonsetigerous small secondary punctures on the pronotum of *knulli* will separate it from *monticolus*. In addition, the distribution of *knulli* is apparently quite distinct from that of the related forms, *knulli* being known only from the mountains in southern Arizona. *O. knulli* can be distinguished from the other species of *Onthophagus* by its opaquely alutaceous, blackish, dorsal surface, well-separated, setigerous, nonannular pronotal punctures, anterior median pronotal protuberance which is always at least vaguely indicated in both sexes, small size, and western range.

The habits of *knulli* are similar to all the general dung feeders. Specimens occur not only under cow and horse dung, but are common at carrion of various vertebrates. Most of the specimens collected by us were taken in the lower elevations of the Chiricahua Mountains between 5000 and 6000 ft. in areas where oaks or other broad-leafed trees furnished appreciable shade. Some specimens were reared in flower pots at the Southwestern Research Station of the American Museum, and though not closely observed, the general developmental picture did not seem to differ appreciably from that described for *alluvius*.

This species is named in honor of J. N. Knull, who started us on this study by submitting for determination two very small specimens of this species.

Onthophagus subaeneus (Palisot de Beauvois)

PLATE 6, FIGURES 54 AND 55

Copris subaeneus Palisot de Beauvois, 1811, p. 105.

Onthophagus subaeneus (Palisot de Beauvois) Haldeman and LeConte, 1853, p. 54.—Lacordaire, 1856, p. 109.—LeConte, 1863, p. 36.—Crotch, 1874, p. 57. (See *concinnus* Laporte, pp. 108 and 112, for discussion of *subaeneus* of other authors.)

Onthophagus cribricollis Horn, 1881, p. 76 (new synonymy).—Henshaw, 1885, p. 87.—Blatchley, 1910, p. 920.—Schaeffer, 1914, p. 297.—Leng, 1920, p. 249.—Boucomont and Gillet, 1927, p. 295.—Leonard, 1928, p. 418.—Sim, 1930, p. 141.—Boucomont, 1932, p. 313.—Cartwright, 1934, p. 238.—Brimley, 1938, p. 199.

MALE MAJORS.—Length 4.2 to 4.8 mm., width 2.4 mm. to 2.7 mm. Head and pronotum shining, dark, iridescent cupreous to green; elytra dully shining, black with cupreous or green cast. Clypeus abruptly reflexed anteriorly, margin broadly emarginate anteriorly, sharply angulate on each side of the emargination, often appearing bidentate; lateral margins obtusely arcuate, often forming a nearly straight edge with the margin of the gena, which curves inward rather abruptly near the eyes; disc with scattered, coarse punctures which are larger laterally, central portions of clypeus and frons forming a low convexity, clypeal carina usually obsolete, occasionally indicated by two small, transverse tubercles, one on either side of the median line. Frons coarsely, often setigerously punctate; carina of vertex obsolete, the surface of the vertex nearly impunctate, smooth and shining; a few scattered punctures near the eyes; genae heavily punctate.

Pronotum completely margined, the anterior angles acute and sharply rounded; lateral margins sharply arcuate at the middle, nearly straight before and behind, only moderately convex with a small rounded conical projection basally no wider than the clypeal emargination, scarcely extending over the pronotal margin; disc of pronotum covered with large, conspicuous, setigerous punctures which are seldom separated by more than 2 diameters, those near the anterior angles and pronotal projection having small tubercles overhanging their forward margins. Elytra with shallowly punctate striae; the intervals, except for the sutural one, generally biseriately tuberculate; at the base of each tubercle a minute puncture bearing a conspicuous, whitish seta; surface of the intervals between the tubercles shining, very finely alutaceous.

Pygidium with rather evenly distributed, large, shallow punctures bearing long, whitish setae; the impunctate areas smooth, shining, cupreous green. Ventral surfaces smooth and shining with iridescent reflections. Metasternum with coarse, setigerous punctures similar to those on the pygidium; the punctures small medially; the median line either absent or impressed in the posterior half of the metasternum. Abdominal segments with a basal row of setigerous punctures, last segment emarginate to receive the pygidium. Legs with all the femora coarsely punctate and longer than in the females, the fore-femora extending beyond the lateral pronotal margin; foretibia slightly longer than the femur, thin and bent inwardly in the anterior half,

outer margin quadridentate, with the margin above and between the teeth serrate or denticulate, a small pencil of hairs beside the apical spine.

MALE MINORS.—Length 3.3 to 4.2 mm., width 2.0 to 2.4 mm. Differing from the male majors in the following respects: Clypeus not as extended or as reflexed anteriorly, still emarginate and bidentate; disc more coarsely, heavily, setigerously punctate; clypeal carina pronounced, straight, its length usually not more than the width of the anterior clypeal emargination; frons and genae coarsely punctate as on the clypeus; carina of vertex evident, but no higher than clypeal carina, very broadly V- or U-shaped, the terminal portions directed anteriorly and very slightly raised, scattered coarse punctures behind the carina.

Pronotum with anterior angles less acute than in male major, anterior projection obsolete or vaguely indicated; punctures larger, anteriorly lacking the overhanging tubercle, but with long, conspicuous, whitish setae; posterior margins often less distinct than in male majors. Elytra essentially similar but with smaller tubercles on the intervals, the setae slightly longer in the male minors.

Pygidium and ventral surfaces with somewhat more pronounced punctures but generally similar to the male major except for the legs. In the male minor the legs not lengthened, being very similar to those of the females; the forefemur not extending to the pronotal margin and the foretibia reduced similarly, broader, and not bent in apical half.

FEMALES.—Length 3.4 to 5 mm., width 1.9 to 2.6 mm. Differing from the male majors in almost the same respects as the male minors. Clypeus broadly emarginate, bidentate, and scarcely reflexed anteriorly; its surface and that of the frons and genae coarsely, setigerously punctate; clypeal carina as described for male minor but often slightly longer; carina of vertex usually slightly higher than clypeal carina, broadly U- or V-shaped with the lateral terminations slightly raised, vertex behind the carina with scattered coarse punctures.

Pronotum less convex and more heavily punctate than in male majors, each puncture bearing a long, whitish seta and the anterior punctures often having a small tubercle on their forward margins; pronotal projection only faintly indicated by an anterior, scarcely noticeable median swelling adjacent to the margin. Elytra similar to those of males but with the setae and tubercles of the intervals more pronounced. Pygidium convex, coarsely punctate with conspicuous setae. Ventral setae and punctures pronounced, the smooth surfaces with the iridescent color often less than in the males. Last abdominal segment not narrowed medially. Legs not greatly elongated, the forefemora not extending to the lateral pronotal margins; the foretibia

short, stubby, quadridentate, not bent in apical half, and lacking the pencil of hairs often present near the tibial spine in the male majors.

TYPE.—Of *subaeneus:* Unknown to us. Of *cribricollis* Horn: Lectotype, present designation, labelled "Tex," in the Philadelphia Academy of Natural Sciences, Type 3571. The lectotype is an extremely small brownish castaneous specimen with a faint greenish lustre. Length 3½ mm. The USNM collection contains a specimen from Plummers Id., Maryland, which duplicates the size and color of the lectotype.

TYPE LOCALITY.—Of *subaeneus:* United States. Of *cribricollis:* Texas.

SPECIMENS EXAMINED.—261.

DISTRIBUTION.—(See fig. 8, p. 64.)

ALABAMA: De Soto State Pk., Monte Sano State Pk. DISTRICT OF COLUMBIA. FLORIDA: Levy Co., Gainesville. GEORGIA: Barnesville. ILLINOIS: White Heath, St. Claire Co. INDIANA: Lawrence Co. KANSAS: Lawrence. MARYLAND: Beltsville, Bladensburg, Plummers Id. MISSOURI: Mountain Grove, St. Louis. NEW JERSEY: Buddtown, Lakehurst, Mt. Misery, Pemberton, Rancocas Park. NORTH CAROLINA: Franklin Co., Halifax Co., Raleigh, Sampson Co., Wilson Co. OHIO: Hocking Co., Columbus. OKLAHOMA: Payne Co., Stillwater. PENNSYLVANIA: Williamson. SOUTH CAROLINA: Cashiers Valley Rd. (Oconee Co.), Clemson, Florence, Jocassee, Liberty, Rocky Bottom (Pickens Co.), Walhalla. TENNESSEE: Burrville, Chester Co., Great Smoky Mtn. Nat. Pk., Memphis, Roane Co. TEXAS: Jacksonville, Paris. VIRGINIA: Basye, Chatham, Clifton, Falls Church.

REMARKS.—This small iridescent species, never commonly collected but having an extended range, can be distinguished from other North American *Onthophagus* by its broadly emarginate bidentate clypeus, its completely margined pronotum which is conspicuously punctate, the long, whitish setae present dorsally and ventrally, the small, median conical protuberance near the anterior pronotal margin in male majors, and by the carinae of the head in male minors and females.

Brown (1926) found *O. subaeneus* (*cribricollis*) in moist woodlands and postulated that the species might feed on decaying organic matter on the floor of woodlands. It was collected by sifting debris from the ground in a moist woods. It has been taken frequently in early spring (February) at Florence, S. C., in sifting woods trash for hibernating boll weevils. It has also been taken at fungi, at carrion, under the dung of various animals, and even "under chicken manure." Some specimens have been taken in malt or malt and propionic acid traps.

The most comprehensive study of *subaeneus* (*cribricollis*) was done in New Jersey by Sim (1930, p. 141) who stated:

> My own records began with June 25, 1926, when one was found under a rabbit pellet in the small pine Barren at Rancocas Park, five miles from Mount Holly.

Between that date and July 9, seventy specimens were collected under rabbit droppings in the same place; twenty-seven being taken on July 4. In 1927, fifty were collected in the same locality, all within an area one-eighth mile in diameter. The best days were July 20 and 21, on each of which twelve of the beetles were collected. All specimens were taken at rabbit pellets. Thus two seasons' collecting resulted in 120 specimens. The beetles were most active on warm sunny days after showers, and practically all were found between 9 A.M. and noon. None was ever observed on the wing in the afternoon or on a cloudy morning. As in all species of *Onthophagus* whose habits are known to me, *cribricollis* buries its food where found and sinks it vertically to a depth of a few inches, where the subsequent grub lives in a double walled plaster cell of its own manufacture. The entire metamorphosis was found to require about one month. As in other species, this beetle probably overwinters as a hibernating adult buried singly at a depth of several inches.

It seems odd that the name *subaeneus* (Palisot de Beauvois) could ever have been used for the species at times called *O. protensus* Melsheimer and here recognized as *O. concinnus* Laporte. The original description of *subaeneus* (Palisot de Beauvois) details several major differences, and the illustration is completely at variance with *concinnus* Laporte. The latter is a larger, brightly shining, bicolored green and yellow, strongly tuberculate species having in the male a flat, somewhat bifurcate pronotal projection and median upturned clypeal process, whereas *subaeneus* (Palisot de Beauvois) is punctate, unicolorous, moderately shining, black with cupreous or greenish cast, and has in the male a short conical pronotal protuberance and bidentate clypeus. The illustration accompanying the original description of *subaeneus* shows a figure with bidentate clypeus and no evidence of bicolored elytra. The size of the species is indicated and measures 4 mm.

Onthophagus knausi Brown

PLATE 6, FIGURES 56 AND 57

Onthophagus knausi Brown, 1927, p. 130.—Boucomont, 1932, p. 312.—Leng and Mutchler, 1933, p. 38.

Onthophagus anthracinus Dawson, p. 73 (not Harold, 1873, p. 911).

MALE MAJORS.—Length 4.3 to 4.9 mm., width 2.4 to 2.6 mm. Black, moderately shining, sometimes with cupreous reflections on head and pronotum; elytra opaque to weakly shining; ventral surfaces piceous, legs usually slightly lighter in color. Head with clypeus sharply reflexed anteriorly, poorly so laterally, reflexed portion distinctly emarginate, angulate laterally, giving clypeus a bidentate appearance; disc of clypeus flat with scattered coarse setigerous punctures, clypeal carina absent, posterior portion of clypeus and anterior of frons slightly tumid, frons finely alutaceous and coarsely, moderately punctate; vertex lacking carina, alutaceous with scattered

punctures; gena with margin abruptly rounded before the eye, surface alutaceous with a few scattered, setigerous punctures.

Pronotum margined anteriorly, laterally, and indistinctly so basally; anterior angles abruptly rounded; quite strongly convex with small, rounded, cone-shaped anterior, median protuberance overhanging margin, its base usually slightly wider than clypeal emargination. Disc shallowly, densely punctate; the punctures separated by less than 1 diameter, varying in size, annular in appearance, with the larger punctures each bearing a distinct seta in the center; surface between punctures very finely alutaceous, becoming more noticeably so near the median posterior margin. Elytra with shining, very shallow, irregularly punctate striae; intervals irregularly, biseriately tuberculate, the second, third, fourth, and fifth often apparently having only single rows; each tubercle with a fine, reddish seta at posterior edge; surface of intervals between the tubercles very noticeably alutaceous.

Pygidium only convex apically, shallowly, setigerously punctate; surface alutaceous basally, becoming smooth and shining at the apex. Ventral surface of thorax and abdomen between setigerous punctures smooth medially, alutaceous laterally. Abdominal segments setigerously punctate along basal margin, punctures sometimes obsolete medially; last segment emarginate medially to receive the pygidium. Forelegs elongate, the femora extending at least as far as the lateral pronotal margins; tibia likewise lengthened, bent in apical third, outer margin quadridentate, serrate or denticulate between and above the teeth, apex with a single or bidentate projection above the apical spur and with a small, yellow pencil of hairs usually present. Femora of all legs moderately, coarsely, setigerously punctate.

MALE MINORS.—Length 3.6 to 4.2 mm., width 2.0 to 2.3 mm. Differing from male majors in the following respects: Head with clypeus shallowly reflexed anteriorly, broadly emarginate, laterally less distinctly angulate; disc of clypeus coarsely, closely punctate; clypeal carina still obsolete; frons and genae similar to those described for male majors. Vertex with a low, poorly delimited carina which is highest laterally, bent posteriorly, and depressed medially; alutaceous and with scattered, coarse punctures behind carina.

Pronotum similar to male majors except that the protuberance is only faintly indicated by a rounded, anterior swelling. Elytra and pygidium not significantly different. Ventral surfaces not noticeably differing from the male majors. Forelegs not greatly lengthened, the femora not reaching the lateral pronotal margins, the foretibiae slender, but not greatly lengthened, the conical projections and pencil of hairs usually reduced or lacking.

FEMALES.—Length 3.5 to 5 mm., width 2.3 to 2.7 mm. Differing from male majors in the following respects: Head with clypeus scarcely reflexed anteriorly, not at all laterally; clypeus anteriorly emarginate with the emargination laterally sharply delimited by abrupt angulations giving clypeus a bidentate appearance; disc coarsely, rugosely punctate; clypeal carina present but not very strong, highest medially. Frons and genae coarsely setigerously punctate; vertex with low, transverse carina complete, depressed, and bent posteriorly at the midline; surface behind carina alutaceous and bearing a few coarse, setigerous punctures.

Pronotum less convex than in male majors, the anterior pronotal protuberance obsolete, otherwise similar. Elytra with tubercles, setae, and alutaceous sculpture usually more pronounced than in the males. Pygidium less convex apically, punctures more pronounced. Ventral surfaces with punctures and setae often more obvious than in males. Last abdominal segment not narrowed medially. Forelegs not lengthened, femora not reaching lateral pronotal margins. Foretibia short, rather stocky, with the four teeth pronounced; outer margin denticulate or serrate between and above the teeth; tibial apex lacking conical projection and pencil of hairs. Legs in other respects similar to those of males.

TYPE.—Canadian National Collection 2461.

TYPE LOCALITY.—Morris Co., Kansas.

SPECIMENS EXAMINED.—60.

DISTRIBUTION.—(See fig. 5, p. 37.)

ILLINOIS: White Heath. KANSAS: Douglas Co., Lawrence, Morris Co., Topeka. NEBRASKA: Bennet, Omaha. TEXAS: Abilene, Austin, Camp Stanley (Bexar Co.), Dallas, Garner State Pk., Kerrville, Kott ranch (Gillespie Co.).

REMARKS.—*Onthophagus knausi* is easily distinguished from species occurring north of Mexico by its small size, emarginate clypeus, densely annularly punctate pronotum, and irregularly biseriately tuberculate, opaquely alutaceous elytral intervals. A Central American species, *O. digitifer* Boucomont, is similar to *knausi* but is even smaller and has a more densely punctate pronotum and more conspicuous elytral setae.

Little is known concerning the life history of *O. knausi*, which is a relatively rare species ranging from Illinois and Nebraska to south-central Texas. L. J. Bottimer has taken a number of specimens in the vicinity of Kerrville, Tex., on deer droppings and more rarely on other types of dung. Many of the specimens were taken in April. Nothing is known concerning food utilized by the larvae.

Onthophagus aciculatulus Blatchley

PLATE 9, FIGURES 83 AND 84

Onthophagus aciculatulus Blatchley, 1928, p. 128.—Blackwelder and Blackwelder, 1948, p. 30.

Onthophagus alutaceus Blatchley, 1919, p. 31 (not Wiedemann, 1823, p. 14).—Leng and Mutchler, 1927, p. 38.—Blackwelder and Blackwelder, 1948, p. 30.

Onthophagus aciculatus Leng and Mutchler, 1933, p. 38.—Blackwelder and Blackwelder, 1948, p. 30.

MALES.—Length 3.8 to 4.5 mm., width 2.5 to 2.6 mm. Black, moderately shining; legs dark piceous. Clypeus moderately reflexed anteriorly, edge flat laterally; widely shallowly emarginate anteriorly, weakly dentate or angulate each side of the emargination, lateral margins only slightly arcuate, nearly straight; genae finely, slightly reflexed, widely rounded, not prominent. Entire surface of head very finely alutaceous; clypeus and genae tuberculate-punctate, the small, fine tubercles grouped in short transverse rows and the accompanying punctures bearing short, inconspicuous setae; clypeal carina absent; frons smoother than clypeus but with scattered shallow punctures separated by 2 to 3 or more diameters, their accompanying tubercles inconspicuous; frontal carina represented by two widely separated, elongated, very noticeable tubercles; punctures of vertex as on frons; eyes quite large and wide, twice as long as wide, about 7 facets wide.

Pronotum finely, completely margined; anteriorly with a small, median, conical protuberance. Surface of pronotum rather coarsely, setigerously tuberculate-punctate over anterior third, more noticeably so over declivity, elsewhere with simple shallow setigerous punctures; the punctures evenly distributed, everywhere separated by about 1 diameter. Setae fine, slightly longer than distance between punctures, surface between punctures finely alutaceous. Elytral striae fine, strial punctures shallow, not conspicuous; intervals flat, alutaceous, setigerously punctate-tuberculate, the small, fine tubercles arranged in one or two irregular rows; setae fine and not very conspicuous, about as on pronotum.

Pygidium apically convex, smooth and shining, basally alutaceous; moderately, coarsely punctate, the punctures deeper apically, separated generally by about 1 diameter. Underside more shining; femora and metasternum shining, smooth at middle; metasternum with scattered, moderate punctures; abdominal segments with the usual transverse rows of punctures reduced to minute, inconspicuous, setigerous punctures bearing very fine setae. Anterior legs not unusually long or slender but probably more so than those of the females; the anterior tibia ending in a small tooth above the spur.

FEMALES.—Unknown.

TYPE.—In Blatchley collection, Purdue University, Lafayette, Ind.

TYPE LOCALITY.—Dunedin, Fla.
SPECIMENS EXAMINED.—3 males, including holotype.
DISTRIBUTION.—(See fig. 8, p. 64.)

FLORIDA: Dunedin, Pasco Co.

REMARKS.—Dr. Blatchley's holotype (by monotypy) was collected "on the wing" at Dunedin, Jan. 7, 1918. His second specimen, also from Dunedin, was taken Jan. 22, 1921. The third specimen seen was collected in Pasco County, Fla., 20 to 50 miles northeast of Dunedin, March 20, 1957, by H. V. Weems, Jr. Nothing further is known concerning this species.

O. aciculatulus is perhaps nearest *O. oklahomensis* in size but is also similar to small *O. pennsylvanicus* and *O. tuberculifrons*. However, it is separated from all these by the conical pronotal protuberance of the males, the shallow pronotal punctures, and the larger, wider eyes. It is also quite similar to *O. subaeneus* which, however, is usually very shiny, has a greenish or coppery lustre, lacks tubercles on the clypeus, and is much more hairy.

Onthophagus oklahomensis Brown

PLATE 6, FIGURE 58

Onthophagus oklahomensis Brown, 1927, p. 128.—Boucomont, 1932, p. 319.—Leng and Mutchler, 1933, p. 38.

In this species, no differences in the often sexually dimorphic morphological features of the males were noted; the following description, therefore, omits separate descriptions of "major" and "minor" males.

MALES.—Length 2.8 to 3.9 mm., width 1.8 to 2.4 mm. Dorsal color black, elytra occasionally piceous; head and pronotum shining, elytra dull but less so than in *O. pennsylvanicus*; ventral color piceous to black, legs brown to piceous. Head with clypeus rounded, sometimes slightly truncate apically, margin slightly, rather evenly reflexed; disc finely punctate medially, with scattered, coarse, setigerous punctures laterally; clypeal carina obsolete, but indicated by a broad convexity at the juncture of the clypeus and the frons; frons nearly flat with scattered fine and coarse punctures; genae scarcely produced, depressed, the surfaces with occasional punctures; vertex usually with a vague, transverse ridge indicating the obsolete carina; surface behind the ridge with scattered, coarse, setigerous punctures.

Pronotum completely margined, poorly so posteriorly; anterior angles abruptly rounded; disc weakly convex, lacking any protuberance, heavily punctate with a mixture of large and small punctures. The large punctures shallow, centrally setigerous and separated by more than 1 diameter; smaller punctures, much less numerous, scattered

over the disc, lacking setae, and usually less than a third the diameter of the larger punctures; surface between the punctures shining, smooth or finely alutaceous. Elytra with shallowly punctate striae; intervals with one or two rows of small tubercles, each with a seta at its base; surface dully shining, finely alutaceous.

Pygidium convex, coarsely, setigerously punctate, and alutaceous basally. Ventral surfaces of thorax and abdomen laterally alutaceous, coarsely, setigerously punctate except in the median posterior portion of the metasternum where the punctures lack setae and are often small or obsolete. Abdominal segments with a basal row of setigerous punctures which often become obsolete medially; last segment slightly emarginate medially. Legs similar in the two sexes. Forelegs of males not noticeably lengthened, tibia short, stocky, quadridentate, outer margin serrate or denticulate between and above the four teeth; apex lacking any projection or pencil of hairs. Femora of all legs with a few scattered fine and coarse setae on their ventral surfaces. In *O. pennsylvanicus* the punctures are usually larger and more numerous.

FEMALES.—Length 2.7 to 4.1 mm., width 2.0 to 2.7 mm. Differing from the males in the following respects: Head with clypeal disc slightly more heavily punctate, sometimes laterally faintly rugose. Clypeal carina usually slightly developed, evident as a low ridge, highest medially and extending the width of the frons; carina of vertex obsolete, no better developed than in males. In other respects head, pronotum, and elytra similar to males. Pygidium less convex, nearly flat except near apex. Ventral surfaces and legs similar to males except for the last abdominal segment which is not narrowed medially.

TYPE.—Canadian National Collection 2459.

TYPE LOCALITY.—Payne Co., Okla.

SPECIMENS EXAMINED.—2572.

DISTRIBUTION.— (See fig. 3, p. 24.)

ALABAMA: Claiborne. ARKANSAS: Fouke, Lawrence Co. DISTRICT OF COLUMBIA. FLORIDA: Statewide (25 localities). GEORGIA: Banbridge, Billys Id. (Okefenokee Swamp), Fort Valley, McRae, Millen, Newton, Spring Creek (Decatur Co.), Swainsboro, Upson Co., Vidana. KANSAS: Medora. LOUISIANA: State label only. MISSISSIPPI: Gulfort, Perkinston. NORTH CAROLINA: Carthage, Faison, Raleigh, Southern Pines, West End. OKLAHOMA: Grady Co., Lattimer Co. SOUTH CAROLINA: Statewide (21 localities). TENNESSEE: Burrville. TEXAS: Amarillo, Aransas National Wildlife Refuge, Bailey Co., Brazos, Bastrop, Calhoun Co., Canadian, Colorado Co., Fedor, Lee Co., Montague Co., Pleasanton, Victoria. VIRGINIA: Nelson Co.

REMARKS.—*Onthophagus oklahomensis* is one of the smallest of the North American species. It may be distinguished by its small size, black or piceous color, round clypeus slightly truncate anteriorly,

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shining, punctate pronotum with punctures of two sizes, tuberculate elytral intervals, lack of secondary sexual characteristics of the pronotum and legs in the males, slightly developed or obsolete carinae of the head of both sexes, and the lack of pronounced rugosity on the clypeus of the females. The species is very closely allied to *O. pennsylvanicus* from which it may be separated by the presence of a more shining pronotum, the mixed pronotal punctures of two sizes, feebly developed carinae of the head, more pronounced posterior pronotal margin, and less punctate femora.

The habitat preference of *O. oklahomensis* differs from *pennsylvanicus*, for though both species are sometimes taken together, the former is restricted almost entirely to sandy areas. It is commonly taken in the sandhill regions of the southeastern coastal plain as well as in sandy areas in Oklahoma and Texas. The species appears to be generally a dung feeder, making shallow 1-to-3-inch burrows under or beside piles of cow dung. Besides being attracted to dung, adults come readily to rotten melon rind, bananas, and malt and propionic acid traps. In the laboratory, cow manure was used by the beetle for construction of small oval cells buried 1 to 2 inches deep in packed sandy clay. Sand grains coating the cells made them difficult to measure, but 11 cells averaged approximately 10 mm. long by 8 mm. wide. In this species as in *pennsylvanicus*, development from egg to adult takes about 3 weeks or slightly longer. Several of the cells were formed about June 25, and on July 17 some contained pupae or teneral adults. The length of the various instars was not ascertained.

Onthophagus pennsylvanicus Harold

PLATE 6, FIGURES 59 AND 60

Onthophagus ovatus Melsheimer, 1806, p. 4 (not Linnaeus, 1767, p. 551).—Say, 1835, p. 174.—Dejean, 1836, p. 158.—Sturm, 1843, p. 108.—Haldeman and LeConte, 1853, p. 54.—LeConte, 1863, p. 36.—Gemminger and Harold, 1869, p. 1034.—Crotch, 1874, p. 57.—Austin, 1880, p. 25.—Leonard, 1928, p. 418.

Onthophagus moeris Sturm, 1826, p. 178 (attributed to Melsheimer; nomen nudum).

Onthophagus pennsylvanicus Dejean, 1836, p. 158 (nomen nudum).—Sturm 1843, p. 108 (nomen nudum).—Gemminger and Harold, 1869, p. 1034 (nomen nudum).—Harold, 1871, p. 115.—Horn, 1875, p. 141.—Austin, 1880, p. 25.—Henshaw, 1885, p. 87.—Blatchley, 1910, p. 920.—Schaeffer, 1914, p. 297.—Leng, 1920, p. 249.—Dawson, 1922, p. 179.—Boucomont and Gillet, 1927, p. 207.—Boucomont, 1932, p. 318.—Lindquist, 1933, p. 120; 1935, p. 8.—Ritcher, 1945, p. 15.

Onthophagus falcipes Harold, 1871, p. 115.

MALE MAJORS.—Length 4.3 to 5.0 mm., width 2.7 to 3.2 mm. Dorsal color piceous or black, usually black and dully shining; ventral surfaces usually black with legs piceous. Head with clypeus moderately reflexed and slightly prolonged anteriorly, the reflexed

portion with margin slightly emarginate, truncate, or broadly rounded; lateral portions scarcely reflexed, obtusely rounded. The disc nearly flat, smooth, and shining, with occasional widely separated coarse or fine punctures; the carina absent; frons nearly flat, alutaceous, and finely punctate; vertex lacking any trace of the transverse carina, more heavily alutaceous and punctate than frons. Genae depressed, shining, and with a few coarse punctures; delimited from clypeus and frons by faint lines; margins of genae scarcely extending beyond clypeal margins.

Pronotum margined anteriorly and laterally, sometimes faintly so posteriorly; anterior angles scarcely obtuse, sharply rounded. Disc moderately convex, lacking any type of pronotal protuberance, although the anterior median portion may be slightly swollen; surface covered with large, shallow, setigerous punctures usually separated by at least 1 diameter, the punctures near the anterior margin sometimes bearing conspicuous tubercles at their anterior edge. Rarely occasional specimens having a few small punctures scattered between the large ones near the posterior midline; even the small punctures, however, often bearing setae; surface between punctures finely alutaceous. Elytra with shining, shallowly punctate striae; intervals with rows of small tubercles bearing setae at their bases, the smooth surfaces dully alutaceous; at least third, fourth, and fifth intervals with tubercles arranged in two irregular rows.

Pygidium convex near apex, coarsely, setigerously punctate; surface smooth and shining between punctures except basally where it is often finely alutaceous. Ventral surfaces of thorax and abdomen alutaceous laterally and with scattered, coarse, shallow, setigerous punctures lacking only near the midline of the metasternum. Ventral abdominal segments, except for first, with a basal row of setigerous punctures often obsolete near the midline, last segment broadly emarginate to receive the pygidium. Forelegs elongated, the apex of the front femora extending to or nearly to the lateral pronotal margin; foretibia likewise elongated (but not to the extent noted for *O. landolti texanus* and others), moderately slender, bent inwardly in apical half, quadridentate, the margin between and above the teeth denticulate or serrate; tibial apex with a conical projection above the spine and usually with a pencil of hairs beside the projection. Femora of all the legs ventrally with scattered coarse and fine punctures, the mesothoracic and metathoracic legs not differing greatly between the sexes.

MALE MINORS.—Length 3.6 to 4.2 mm.; width 2.3 to 2.6 mm. Differing from the male majors in the following respects: Head with clypeus at least slightly reflexed both anteriorly and laterally, the disc more heavily setigerously punctate, the carina obsolete; vertex

with nearly straight carina present but not pronounced, often obsolete or depressed medially; scattered, coarse, setigerous punctures behind it. Pronotum less convex, alutaceous appearance and punctures more pronounced than usual in male majors. More conspicuous punctures or tubercles are often noted on elytral, pygidial, and ventral surfaces of male minors, but in other respects these areas do not differ significantly from the male majors. Forelegs of male minors not greatly elongated but not as robust nor with the four teeth as large as in females, the apical conical projection small or absent, the pencil of hairs lacking, and the tibia only slightly bent in outer half. In other respects the legs do not differ greatly from the male majors.

FEMALES.—Length 3.3 to 4.6 mm.; width 2.1 to 2.8 mm. Differing from male majors in the following respects: Head with clypeal margin shallowly reflexed anteriorly and laterally, usually broadly emarginate anteriorly; disc coarsely, often rugosely, setigerously punctate; clypeal carina present, highest medially; frons alutaceous with scattered, coarse, setigerous punctures; carina of vertex straight, often depressed medially and no more pronounced than clypeal carina, vertex behind carina with an irregular row of setigerous punctures. Pronotum less convex, the punctures and setae often more pronounced than in male majors. Punctures of elytra, pygidium, and ventral surfaces likewise often more pronounced, but not differing greatly in other respects. Last abdominal segment not narrowed medially. Forelegs not lengthened, the apex of the front femora not extending to pronotal margin. Foretibia stocky and nearly straight; the four marginal teeth large, the margin serrate between and above the teeth; apical projection and pencil of hairs lacking. Legs in other respects similar to male.

TYPE.—Unkown to us.

TYPE LOCALITY.—"Pennsylvania, Kentucky."

SPECIMENS EXAMINED.—1428.

DISTRIBUTION.—(See fig. 2, p. 20.) Colorado, South Dakota, and all States east and south of these except New Mexico, Vermont, and Maine.

REMARKS.—Several early workers confused this species with the common European *O. ovatus* (Linnaeus); this confusion persisted in our literature as late as 1928 when Leonard listed the name in his "Insects of New York." We have seen no specimens of *ovatus* from North America. Hamilton (1889) and others have pointed out the error in early records.

O. pennsylvanicus is a common, wide-ranging eastern species that may be distinguished from related species by the uniform dull or feebly shining black or piceous color, the unornamented pronotum which is coarsely, rather uniformly punctate; each puncture usually bearing a reddish seta and separated from its neighbor by approximately a

diameter, the tuberculate elytral intervals (third, fourth, and fifth intervals with two irregular rows), the alutaceous upper surface of pronotum and elytra, and by the male majors with cephalic carinae lacking and forelegs lengthened, the tibia usually having an apical pencil of hairs.

The species occurs from southern Ontario south to central Florida and westward to central Texas. Adults are most commonly collected in areas having a clay-type soil, but also occur in fairly sandy localities. Adult food habits are varied. Specimens have been taken at many types of animal dung, horse, cow, dog, deer, and human being the most common, at carrion, both bird and mammal, and at rotting fungi and watermelon rind. Specimens can be taken in large numbers by using sunken cans baited with a mixture of fermenting malt and propionic acid.

It is not known how many types of animal dung may be used for larval food, but adults brought into the laboratory and placed in large clay-filled flower pots readily utilized cow dung in construction of the cells for their larvae. They made numerous winding burrows, 2 to 3 inches deep, beneath and at the margin of a pile of dung, each burrow terminating in a cell averaging 6 mm. wide by 10 mm. long. When the dung wad was completed, a small cavity was left in the upper end of the dung and in this a single elongate egg was glued by one end so that it was upright in the cavity. Larval development was typically rapid, developmental time from egg to adult having a duration of approximately 3 weeks. Adults were placed in flower pots on June 22; pupae and teneral adults of the F_1 generation were found when the pot was excavated on July 17. The developmental time for each stage was not determined. The discussion of the habits of *O. pennsylvanicus* by Lindquist (1933) may refer to *pennsylvanicus* or to *O. oklahomensis* Brown.

Onthophagus tuberculifrons Harold

PLATE 6, FIGURES 52 AND 53

Onthophagus tuberculifrons Sturm, 1843, p. 108 (nomen nudum).—Gemminger and Harold, 1869, p. 1038 (nomen nudum).—Harold, 1871, p. 115.—Horn 1875, p. 140.—Austin, 1880, p. 25.—Henshaw, 1885, p. 87.—Blatchley, 1910, p. 919.—Schaeffer, 1914, p. 298.—Leng, 1920, p. 249.—Boucomont and Gillet, 1927, p. 208.—Boucomont, 1932, p. 319.

Onthophagus tuberculatus (Zimmermann in litt.) Gemminger and Harold, 1869, p. 1038 (nomen nudum).—Harold, 1871, p. 115.

MALE MAJORS.—Length 4.6 to 5.5 mm., width 2.8 to 3.1 mm. Black with brown spotted elytra, at least with spots at humeri and apices; head and pronotum dully shining, sometimes with cupreous cast, elytra opaque. Head with clypeus widely rounded, slightly,

evenly reflexed and anteriorly shallowly emarginate; disc flat, shining, coarsely, setigerously punctate; clypeal carina absent; frons and genae coarsely, setigerously punctate, finely alutaceous; margin of genae not delimited from that of clypeus; frontal carina indicated by two small truncate tubercles, one near each eye, the vertex between and behind the tubercles coarsely punctate and finely alutaceous.

Pronotum margined anteriorly and laterally, poorly so posteriorly, anterior angles abruptly rounded; disc weakly convex, without pronotal protuberance; coarsely, shallowly, setigerously punctate; pronotal punctures separated by 1 to 2 diameters, each puncture usually bearing a very small tubercle at its anterior margin; tubercles becoming pronounced near the anterior margins, surface between them alutaceous. Florida specimens with punctures larger and tubercles often lacking, but in other respects they do not differ from the main population. Elytra with shallow, poorly to moderately punctate striae; intervals, except for sutural one, biseriately tuberculate, each tubercle bearing a short seta at its base, surface alutaceous between tubercles.

Pygidium setigerously punctate, the punctures indistinct, surface alutaceous, sometimes becoming smooth near the apex. Ventral surfaces of thorax and abdomen alutaceous laterally and coarsely, setigerously punctate except at midline of the metasternum and abdomen where the punctures often are obsolete. Abdominal segments with a basal row of setigerous punctures, the last segment emarginate to receive the pygidium. Legs not differing noticeably from those of female. Foreleg not greatly elongated, tibia short and stocky, the four teeth large, with outer margin denticulate-serrate between and above the teeth; tibia lacking sexual modification such as an apical projection or pencil of hairs.

Male minors.—Length 3.8 to 4.4 mm., width 2.4 to 2.8 mm. Differing from male majors in the following respects: Clypeus not so widely rounded nor as deeply reflexed, disc slightly more heavily punctate; clypeal carina faintly indicated by a short raised ridge near the midline. In other respects, except for slightly more pronounced punctures and setae, the male minors do not differ significantly from the male majors.

Females.—Length 3.9 to 5.7 mm., width 2.4 to 3.3 mm. Differing from male majors in the following respects: Clypeus abruptly moderately reflexed anteriorly, the reflexed portion sharply emarginate and laterally angulate, the clypeus therefore appearing bidentate; disc of clypeus more tuberculate than punctate, the tubercles often appearing as short, irregular, transverse ridges; clypeal carina low, most distinct medially, usually not reaching the juncture of clypeus and genae; surface of genae indistinctly ridged or very coarsely, setigerously punctate; surface of frons and vertex not differing greatly

from that of males; carina of vertex as in males but reduced, sometimes only faintly visible.

Pronotum and elytra as noted for male minors. Pygidium less convex and more conspicuously setigerously punctate than is usual in male majors. Ventral surfaces and legs generally similar to male minors except that the last abdominal segment is not narrowed medially.

TYPE.—Location unknown to us.

TYPE LOCALITY.—"Carolina."

DISTRIBUTION.—(See fig. 9.)

ALABAMA: Hartford, Mobile, Seale. ARKANSAS: Washington Co. CONNECTICUT: State label only. DISTRICT OF COLUMBIA. FLORIDA: 50 localities throughout the State. GEORGIA: 10 mi. west of Fort Valley, Rabun Bald Mtn. (Rabun Co.), Satoloh. INDIANA: Lake Station, Pine. ILLINOIS: Kankakee Co. (Hopkins Pk.), LaFayette. KANSAS: Corbin, Medora. MARYLAND: State label only. MICHIGAN: Livingston Co. (George Reserve). NORTH CAROLINA: Asheville, Balsam, Black Mts., Faison, Southern Pines, Sunburst, Victoria. NEW JERSEY: Bayhead, Burlington Co., Cassville, Clementon, DaCosta, Jericho, Lakehurst, Lucaston, Millville, Rancocas Park, Warren Grove. OKLAHOMA: Payne Co. SOUTH CAROLINA: Beaufort, Cashiers Valley Rd., Clemson, Chappells, Columbia, Denmark, Florence, Hartsville, Meredith, Rocky Bottom, Ware Shoals, White Pond, Venus (Pickens Co.). TENNESSEE: Burrville, Chilhowee Mtn., Knoxville. TEXAS: Anderson Co., Bastrop State Pk., Goliad. VIRGINIA: Norfolk.

REMARKS.—*Onthophagus tuberculifrons* is characterized by its dull black or faintly cupreous color with brown spotted elytra; clypeus emarginate, seemingly bidentate; carina of vertex bituberculate with

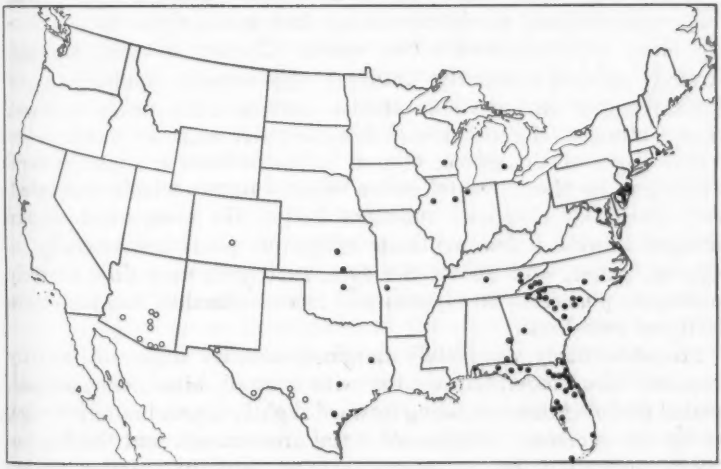

FIGURE 9. Distribution of species of *Onthophagus:*

○ *velutinus* Horn ● *tuberculifrons* Harold

central portion obsolete; pronotum punctate; elytral intervals biseriately tuberculate and dorsal surface largely alutaceous. Males of this species can be differentiated from the females by the emargination of the last abdominal segment, the pronotum and legs being similar in both sexes.

O. tuberculifrons is found most commonly in sandy localities from Connecticut to Florida and west to Texas, Oklahoma, and Kansas. Specimens are readily collected by the use of sunken cans baited with fermenting malt and propionic acid. Adults are attracted to human, cow, and other types of animal dung as well as fermenting fungi or other vegetable material. Depth of the adult burrows ranges from 2 to 3 inches in moist localities such as the Chilhowee Mountains of Tennessee and from 6 to 7 inches in more xeric habitats such as Southern Pines, N.C.

Brown (1926) stated that "*tuberculifrons* is an eastern species occuring in pine woods along the Atlantic coast from New Jersey to Florida." However, he also found it in a small wood of blackjack oak near Ripley, Okla.

Onthophagus schaefferi, new species

PLATE 6, FIGURES 49–51

Onthophagus landolti Schaeffer, 1905, p. 158; 1909, p. 382; 1914, p. 299 (not Harold 1880, p. 34).—Leng, 1920, p. 249.—Boucomont and Gillet, 1927, p. 206.—Boucomont, 1932, p. 314.—Robinson, 1948, p. 176.

HOLOTYPE.—Male major, length 5.5 mm., width 3.1 mm. Head dull greenish black, pronotum shining dark green, elytra feebly shining black with scattered brown spots. Clypeus broadly, sharply, strongly reflexed anteriorly, upturned edge broadly, shallowly emarginate; angles on each side almost dentate; sides finely reflexed, almost straight, slightly sinuate from anterior angle or tooth to external angle of the genae; clypeal carina absent, a slight general swelling in its place; frontal carina reduced to two widely separated, very short but elongated tubercles behind the eyes; head surface alutaceous with a few moderate setigerous punctures laterally on clypeus, genae, and above the eyes; scattered, very fine, scarcely noticeable punctures on clypeus and more noticeable, fine punctures scattered over front.

Pronotum finely, completely margined, anterior angles not acutely rounded; disc moderately convex with a small, blunt, cone-shaped, medial protuberance extending forward slightly beyond anterior edge, its tip red-cupreous. Surface of discal area smooth and shining between moderately coarse punctures; alutaceous in anterior angles, narrowly so across base and forward, slightly so along the widely,

shallowly, basally depressed midline. Moderately coarse punctures, setigerous laterally and across anterior declivity, where each seta is preceded by a noticeable tubercle; coarse pronotal punctures everywhere quite evenly dispersed, separated by 1 to 2 diameters, a few smaller punctures intermixed on disc. First three elytral striae slightly wider than next four, with very distinct punctures crenating the sides of the intervals; punctures of next four striae wider than the striae, a little like widely spaced beads on a string; intervals flat, alutaceous except outside humeri. Elytra black except for a moderately large yellowish-brown humeral spot at base of intervals 6 and 7; two smaller discal spots on 5th interval roughly one-third and two-thirds distance from base; similar coalescing spots at top of apical declivity from 2nd to 6th intervals.

Pygidium shining and smooth over convex apex, finely alutaceous basally; everywhere with moderately deep, moderately coarse setigerous punctures separated by 1 diameter or less. Underside, including femora, with moderately coarse setigerous punctures throughout, even at middle of metasternum; punctures of the abdominal segments arranged in transverse basal rows. Legs dark brown, anterior pair elongated, the femora extending beyond the thoracic margins; tibiae thin and narrow, longer than femora, arcuately bent at outer third, and terminating with a tuft of long, yellowish hairs and tooth above the spur. Stem of antenna red-brown, club fuscous.

MALE MINORS.—Minor males gradually approach the appearance of females, the pronotal protuberance becoming smaller and smaller almost to complete absence; the tubercles representing the frontal carina becoming more prominent and closer together until they approach the female carina in appearance, and the legs becoming shorter until similar to those of the female; the clypeal carina, however, not showing in any of the male minors available for study.

ALLOTYPE.—Female, length 5.25 mm., width 3.0 mm. Similar to holotype in color except that the yellowish-brown spots of the elytra are less developed. The shoulder spot is about the same, but interval 5 has a small spot slightly posterior to the middle and another near the top of the apical declivity, and interval 6 has a similar small spot apically; no others are visible. The head is similar in outline but the clypeal emargination is deeper and therefore has a more dentate appearance; both carinae are strong and well developed, the clypeal carina rather evenly elevated, only slightly higher medially, the frontal carina shorter then the clypeal carina and notched at middle; surface of clypeus coarsely punctate, slightly rugose transversely, more finely so anteriorly; moderately coarse punctures extending over genae and between and behind the carinae. Forelegs shorter, with heavier tibiae, the tuft of hair and tooth above the spur lacking.

Pygidium more extensively alutaceous; terminal abdominal segment not narrowed apically as in male.

VARIATION.—Greatest variation is in the size, intensity, and number of spots on the elytra of both sexes. The larger humeral spots are nearly all distinct, but conceivably some individuals may show none at all. In some, the spots are all quite bright and distinct; in others, they are dim and indistinct. In greatest development, the humeral spots extend completely across intervals 6 and 7, basally a large spot appears on intervals 3 and 4, and smaller discal spots are found on all except the sutural interval. Forty distinct spots were counted on the elytra of one specimen.

TYPE.—USNM 65685.

TYPE LOCALITY.—Brownsville, Tex.

SPECIMENS EXAMINED.—57.

DISTRIBUTION.—(See fig. 7, p. 59.) Holotype and allotype, Brownsville, Tex., May 24, 1941, W. Goodpaster (Cartwright coll., USNM). And the following paratypes:

UNITED STATES: TEXAS: Brownsville, 2♂♂, 3♀♀, May 24, 1941, W. Goodpaster (USNM); 1 ♀, Apr. 2 (USNM); 4 ♂♂, June 1901 (Schaeffer coll., USNM); 2 ♂♂, May 25, 1939, June 8, 1934, D. J. and J. N. Knull (USNM); 1 ♀, June 8, 1934, D. J. and J. N. Knull (OSU); 1 ♂ (USNM); 1 ♂, 1 ♀, May 10, Dury (H. W. Wenzel coll., OSU); 1 ♀, Oct. 9, 1960, cow dung, L. J. Bottimer (LJB); 4 ♂♂, 2 ♀♀, Wickham (USNM, CNC); 2 ♂♂, 4 ♀♀, Apr. 15, 1903 (USNM, CNC); 2 ♂♂, 4 ♀♀, Apr. 12–May 20 (USNM, CNC); 1 ♂, 1 ♀, Nov. 21, 1911, palm jungle in human dung (USNM); 1 ♂, 2 ♀♀, palm jungle, June 1, 1954, H. F. Howden (Howden). 3 ♀♀, St. Tomas, Brownsville, Brooklyn Museum Cat. 828 (USNM); 1 ♂, St. Tomas, Brownsville, Howden coll. (CNC); 3 ♀♀, Los Borregos, Brownsville, May 24, 1904, H. S. Barber (USNM); 1 ♂, 2 ♀♀, Esperanza ranch, Brownsville, Apr. 4, 1903, June 21, July 30, Brooklyn Museum Cat. 820 and 829 (USNM); 4 ♂♂, 4 ♀♀, Lake Corpus Christi State Pk., June 8, 1954, H. F. Howden (Howden); 1 ♀, southwest Hildalgo Co., May 30, 1947, George B. Vogt (Vogt); 1 ♂, 2 ♀♀, Cameron Co., Nov. 2, 1946, George B. Vogt, dung of opossum or raccoon composed of fruit of *Condalia obovata* Hook (Vogt); 1 ♀, Bentsen-Rio Grande State Pk., June 4, 1954, H. F. Howden, horse dung (Howden); 1 ♂, no data (USNM).

MEXICO: 1 ♀, Jalapa, W. Schauss (Robinson coll., USNM).

REMARKS.—*Onthophagus schaefferi*, *O. landolti texanus*, and *O. hōpfneri* occur together and are frequently confused. They are quite distinct however, and may be separated as follows: In *O. schaefferi* the small round reddish or brownish discal spots first show up on the 5th elytral interval and the spots never form stripes; the elytral apices rarely show solid yellow, but if so, even then the small discal spots remain well separated; the 8th interval is never solid yellow posteriorly. In *landolti texanus* the 5th elytral interval never shows yellow except rarely at base and apex; yellow stripes frequently develop, the yellow color developing as stripes and not as coalescing round spots; the 8th elytral interval is always solid yellow posteriorly.

In *höpfneri* (usually labeled *arizonensis*), the yellow is usually a brighter yellow compared to the reddish yellow or brownish yellow of *schaefferi;* the yellow is always much more extensive, the base and apices of the elytra usually solid yellow with numerous small, round, yellow spots in between; the 8th elytral interval is solid yellow posteriorly.

Dr. A. Villiers kindly checked a specimen of *schaefferi* with Harold's specimens of allied species in the Muséum National d'Histoire Naturelle and reported no similar specimens were represented.

The writers' observations indicate that *O. schaefferi* is less abundant than *l. texanus*, though the two are often taken together in shaded habitats in the lower Rio Grande Valley. They are attracted to excrement of many different animals.

The species is named after Charles Schaeffer whose 1914 revision of *Onthophagus* has served American entomologists for over fifty years

Onthophagus landolti texanus Schaeffer

PLATE 6, FIGURES 46–48

Onthophagus texanus Schaeffer, 1914, p. 299.—Leng, 1920, p. 249.—Boucomont and Gillet, 1927, p. 208.—Robinson, 1948, p. 176.
Onthophagus landolti var. *texànus* (Schaeffer), Boucomont, 1932, p. 314, 326.

MALE MAJORS.—Length 4.6 to 5.3 mm., width 2.8 to 3.1 mm. Head and pronotum shining, piceous to black, rarely with faint greenish cast, usually with anterior angles and anterior lateral margins of pronotum narrowly brown. Elytra variable, frequently black with humeral spots and apical portion yellowish brown, occasionally largely brown, with only sutural interval and parts of intervals behind the humeri black; quite often with alternate black and brown intervals, giving a striped appearance, the sutural and alternate following intervals black, always with a marginal black spot beyond 4th and 5th intervals. Pygidium bicolored, centrally piceous or black, marginally brown; ventral surfaces piceous to black with lateral margins of abdomen and legs brown to dark brown. Head with clypeus extended and abruptly reflexed anteriorly, scarcely reflexed and obtusely arcuate laterally; a bidentate appearance resulting from broadly emarginate and laterally abruptly angulate reflexed portion. Clypeal disc flat and smooth, very finely punctate medially, with a few scattered, moderate, setigerous punctures laterally; clypeal carina absent; frons finely punctate, smooth, shining, and almost flat; genae scarcely flared, surface smooth to finely alutaceous with scattered, moderate, setigerous punctures; vertex slightly elevated but with carina obsolete, surface smooth to alutaceous and nearly impunctate.

Pronotum finely margined anteriorly, laterally and basally very finely at middle; anterior angles sharply rounded; pronotum wider

near the middle, moderately convex with a small median, somewhat flattened, conical projection extending over the anterior margin; the projection basally being scarcely as wide as the reflexed portion of the clypeus; pronotum coarsely punctate except for tip of the projection and for a narrow band just behind the anterior margin; the punctures separated by 1 to 3 diameters and bearing fine, brownish, inconspicuous setae; surface between the punctures smooth and shining to minutely alutaceous except near the median portion of the posterior margin where it may be finely alutaceous. Elytra with faintly punctate, shallow, shining striae; intervals except for sutural interval irregularly biseriately tuberculate, the tubecles bearing small setae at their posterior margins; surface between the tubercles very finely alutaceous. Pygidium coarsely, setigerously punctate, surface between the punctures largely smooth and shining, particularly on and near the convex apex. Ventral surfaces of thorax coarsely, setigerously punctate, laterally with surfaces finely alutaceous; median line of metasternum often slightly indented and impunctate. Abdominal segments each with a basal row of setigerous punctures, often obsolete medially, last segment emarginate medially to receive the pygidium. Forelegs elongated, the apex of the femora extending beyond the lateral margins of the pronotum. Foretibia similarly lengthened, quadridentate; outer margin dentate or serrate between and above the teeth, bent inwardly in apical half, the tip extended over the apical spine and usually bearing a pencil of hairs. Middle and hind legs not greatly elongated, the femora with a few scattered setigerous punctures.

MALE MINORS.—Length 3.1 to 4.1 mm., width 1.8 to 2.8 mm. Differing from the male majors in the following respects: Fully as variable in color, but usually lacking greenish cast on the head and pronotum. Head with clypeus emarginate anteriorly but not greatly reflexed; disc of clypeus, frons, and gena as described for male majors. Clypeal carina absent, the area of the carina sometimes slightly tumid; vertex with a small to moderate, nearly straight carina extending about two-thirds of the distance between the eyes. Pronotum less convex than in male majors with pronotal projection only vaguely indicated, rarely completely absent, punctures extending to anterior margin; pronotum in other respects similar to male majors. Elytra exhibiting all the variations in color mentioned for male majors. Pygidium and ventral surfaces generally similar to those of male majors, but with setae and punctures often more pronounced. Forelegs not greatly extended, femora not extending to lateral margins of pronotum, foretibia short, scarcely bent, lacking apical conical projection over spine and pencil of hair, tibial teeth often slightly larger than in male majors; similar in other respects.

FEMALES.—Length 3.8 to 5.2 mm., width 2.5 to 3.0 mm. Differing from the male majors in the following respects: Color exhibiting all the variations noted including the shining greenish cast. Head with clypeus more sharply emarginate, moderately reflexed anteriorly and laterally; clypeal disc flat, coarsely, almost rugosely punctate; a low clypeal carina present, highest medially; frons and genae with scattered, moderate, setigerous punctures; vertex with a moderate carina extending approximately two-thirds the distance between the eyes, nearly straight and level, occasionally indented medially or bent posteriorly at the ends; vertex behind the carina with scattered coarse punctures.

Pronotum as described for male minors with the pronotal projection either absent or barely indicated, setae often more pronounced than in male majors. Elytra similar except for slightly more pronounced tubercles and setae. Pygidium more evenly convex, otherwise similar; ventral surfaces with more pronounced punctures and setae; last abdominal segment not narrowed medially to receive the pygidium. Forelegs not extended, the femora not reaching the lateral pronotal margins; tibiae stocky, the four teeth larger than in males, margin between and above teeth usually denticulate or serrate; apical projection and pencil of hairs lacking; in other respects not noticeably different from males.

TYPE.—Of *texanus* Schaeffer: Lectotype, present designation, ♀, USNM 42592, Brooklyn Museum Collection, 1929. Cotypes, 2 ♀ ♀, were collected on the Esperanza ranch, Brownsville, Tex., May 29, 1903. Of *landolti* Harold: Muséum National d'Histoire Naturelle, Paris, France.

TYPE LOCALITY.—Of *texanus* Schaeffer: Brownsville, Tex. Of *landolti* Harold: Ocaña, Colombia, and La Guayra, Venezuela.

SPECIMENS EXAMINED.—424.

DISTRIBUTION.—(See fig. 1, p. 17.)

OKLAHOMA: Marietta. TEXAS: Bentsen-Rio Grande State Pk. (near Mission), Brownsville, Lake Corpus Christi State Pk., west Cameron Co., Garner State Pk., southwest Hidalgo Co.

BIOLOGY.—Some specimens were brought back alive to the University of Tennessee, placed in large earth-filled flower pots, and furnished with fresh cow dung. Under these conditions the beetles reproduced readily. The female beetles made winding 3-to-7-inch burrows with a cell of dung at the bottom of each burrow. Twenty cells were measured, the longest being 16 mm., the shortest 10 mm.; in width they ranged from 7 to 11 mm. The average cell was 12 to 14 mm. long and 8 to 9 mm. wide.

The female made the cell by packing the dung into the end of the burrow and making a small cavity in the upper end of the dung. A single elongate oval egg 0.8 to 0.9 mm. long and 0.3 to 0.4 mm. wide was fastened by one end to the side of the cavity. Each female produced from 3 to 30 eggs. Two females placed in a flower pot with a single male produced 55 cells. Development was rapid, the eggs hatching in 2 to 4 days, the first two instars lasting from 7 to 10 days and the third instar 12 to 14 days. (A discussion of the length of development, pictures of the larva and adult, and the effects of gamma radiation on development have been published elsewhere. See Howden, 1957). Larvae that were observed hatching August 2 became pupae on August 31. Before pupation, the larva forms a hard spherical pupal cell of its own feces inside the dung wad. The pupal period lasts only 5 to 7 days but the teneral adult may remain in the pupal cell for several weeks. Once the adult emerges, mating, though not observed, apparently is not long delayed, for females start cell formation shortly after their appearance. It is interesting to note that isolated virgin females do little burrowing in comparison with mated females. Active beetles lived for 2 to 3 weeks under laboratory conditions. At least six generations were reared, starting with the two females fertilized by a single male.

At almost any point in the above cycle, adverse conditions may change the length of time required for development. Either too moist or too dry conditions in the flower pots caused considerable mortality. Moisture favored the appearance of fungi in the cells. However, mites were the most difficult problem to contend with in the flower pots; frequent changes were necessary, because if the adults were left in pots where the mite population was large, the mites would actually kill the beetles. Occasional specimens in the field have been noted infested with mites, but how serious a pest they are to the coprophagous beetles remains an interesting problem.

REMARKS.—Boucomont (1932) placed *O. texanus* as a variety of *O. landolti*, and unquestionably it is very close. We prefer at present to give *texanus* subspecies status. It differs from typical *landolti* in that it is less shining and more noticeably alutaceous. The pronotum is usually black or brown, only rarely with a greenish cast, whereas in *landolti* it is frequently bright green or coppery. The pygidium is always bicolored, often being yellow over more than half its surface, but in *landolti* the pygidium is black or only the edges are narrowly yellow. The apical black spot of the elytral declivity is more rounded higher up, and is opposite the 4th and 5th intervals; in *landolti* the spot is elongate, nearer the edge, and opposite intervals 3, 4, and 5; the males of *texanus* never have the anterior arcuate pronotal carina which is sometimes evident in *landolti*.

There are less noticeable differences in the width and punctures of the elytral striae and in the emargination and teeth of the clypeus. Typical *landolti* is distributed at least as far north as Sonora, Mexico.

O. texanus is frequently confused with *O. höpfneri* Harold and *O. schaefferi*, new species; however, in *texanus* the yellow-brown color of the elytra tends to form longitudinal stripes and never forms round spots on the disc of the elytra.

In southern Texas, *O. texanus* is not uncommon in low shaded areas. The writers took it in numbers in the lower Rio Grande Valley, particularly in the palm jungle at Southmost below Brownsville and in the Bentsen-Rio Grande State Park. Most of the specimens were taken under fresh horse droppings, but some were found at Lake Corpus Christi State Park on watermelon rind and under cow dung.

Onthophagus höpfneri Harold

Plate 6, FIGURES 44 AND 45

Onthophagus höpfneri Harold 1869, p. 512.—Boucomont and Gillet, 1927, p. 206.—Boucomont, 1932, p. 326—Robinson, 1948, p. 176.

Onthophagus arizonensis Schaeffer, 1909, p. 382; 1914, p. 296.—Leng, 1920, p. 249.—Boucomont and Gillet, 1927, p. 204.—Boucomont, 1932, p. 314.—Robinson, 1948, p. 176.

Onthophagus landolti Robinson, 1948, p. 176 (not Harold, 1880, p. 34).

Onthophagus texanus (Schaeffer), Robinson, 1948, p. 176.

MALE MAJORS.—Length 4.7 to 5.1 mm., width 2.7 to 3.0 mm. Head and pronotum shining green to dark green, often with cupreous or violaceous reflections; elytra usually largely brownish yellow with black arcuate median band mottled with small, round yellowish spots, occasionally mostly black with scattered yellow spots; sutural intervals black; legs reddish brown to piceous. Head with clypeus sharply reflexed anteriorly, scarcely so laterally, reflexed portion broadly shallowly emarginate medially and more or less angulate on each side; disc smooth, nearly flat, with only an occasional coarse puncture and a few fine ones; both clypeal carina and the carina of the vertex absent; surface of frons and vertex similar to that of clypeus, only slightly convex; gena delimited from clypeus by a fine line, its surface finely alutaceous and coarsely punctate, margins of genae abruptly rounded near eyes.

Pronotum completely margined, poorly so posteriorly, anterior angles acutely rounded, lateral margins arcuate. Disc of pronotum moderately convex with a somewhat flattened conical median projection extending forward over the head, the protuberance abruptly rounded anteriorly and curved slightly upward; disc coarsely punctate, the punctures separated by a distance equal to 1 to 2 diameters,

the punctures often bearing whitish setae and having a small tubercle at their anterior margins; surface between punctures smooth and shining with scattered fine punctures evident on unabraded specimens, except for a narrow, nearly impuncate, very finely alutaceous area extending across just behind the anterior margin. Elytra with narrow punctate striae; intervals with two or three irregular rows of small tubercles, each with a setigerous puncture at the base, smooth surfaces of intervals finely alutaceous.

Pygidium black, yellow, or bicolored; setigerously punctate; the basal portion alutaceous, the apex smooth and shining. Ventral surfaces of thorax piceous to black with traces of iridescence; alutaceous laterally, smooth and shining medially on the metasternum. Sterna coarsely setigerously punctate except near the finely punctate median line of metasternum; abdominal segments with a basal row of small setigerous punctures, surfaces otherwise finely alutaceous, last abdominal segment emarginate. Forelegs greatly elongated, apex of forefemur extending beyond lateral margin of pronotum; tibia as long as or longer than femur, thin, slightly curved near the apex, laterally quadridentate, with the margin between and above the teeth serrate or denticulate; apex extended slightly over the tibial spine and bearing a small pencil of hairs. Middle and hind legs not greatly elongated; the femora bearing a few coarse punctures in apical half.

MALE MINORS.—Length 3.6 to 3.9, width 2.3 to 2.5 mm. Differing from male majors in the following respects: Head with clypeus not extended nor sharply reflexed anteriorly; the margin vaguely emarginate or truncate medially and broadly arcuate laterally, clypeal disc coarsely punctate, rugosely so laterally, frons and genae with scattered coarse punctures; clypeal carina barely indicated medially; carina of vertex pronounced, nearly straight, slightly depressed at the midline and terminating some distance from the eyes; surface behind the carina with a few coarse setigerous punctures.

Pronotum evenly moderately convex with only a trace of the anterior median pronotal hump; surface coarsely, evenly, setigerously punctate. Elytra similar to those of the male majors except that the tubercles on the intervals sometimes more pronounced. Pygidium quite convex with only basal third alutaceous. Ventral surface with more conspicuous setae, but otherwise similar. Forelegs not elongated, similar to those of females; the foretibiae short, with the four teeth smaller than in females; apical conical projection and adjacent pencil of hairs both lacking.

FEMALES.—Length 3.7 to 5.0 mm., width 2.2 to 3.0 mm. Differing from male majors in the following respects: Head with clypeus not noticeably prolonged anteriorly; clypeal margin slightly reflexed, broadly emarginate anteriorly, moderately angulate on either side

of the emargination; cylpeal disc transversely rugosely punctate, clypeal carina evident, only slightly higher medially, terminating at the genae. Frons and genae with scattered, coarse, setigerous punctures; carina of vertex pronounced, nearly straight, depressed medially and abruptly terminated laterally near the eyes; surface behind the eyes with scattered, coarse, setigerous punctures.

Pronotum differing only slightly from that described for male minors, often showing no indication of the anterior median pronotal projection, the pronotum being evenly rounded anteriorly. Elytra not differing from those of male majors except by having slightly more pronounced tubercles and setae. Pygidium convex apically, surface coarsely punctate, each puncture bearing a conspicuous whitish seta. Ventral surfaces similar to males except for the slightly more evident punctures and setae. Last abdominal segment not narrowed medially. Forelegs not lengthened, the apex of the femora not extending beyond the pronotal margin; foretibia short, stocky, with four large teeth, with the margin denticulate or serrate between and above; apex lacking conical projection and pencil of hairs noted in male majors.

TYPE.—Of *hŏpfneri:* Muséum National d'Histoire Naturelle, Paris, France. Of *arizonensis:* Lectotype, present designation, USNM 42590, ♀, Brooklyn Museum Cat. 824.

TYPE LOCALITY.—Of *hŏpfneri:* Veracruz, Mexico. Of *arizonensis:* Nogales, Santa Cruz Co., Ariz.

SPECIMENS EXAMINED.—247.

DISTRIBUTION.—(See fig. 5, p. 37.)

UNITED STATES: ARIZONA: Atascosa Mtn., Baboquivari Mts., Douglas, Nogales, Patagonia, Portal (Southwestern Research Station), near San Fernando, Santa Rita Mts., Tucson.

MEXICO: NAYARIT: Jesús María, Navarrete. MORELOS: 7 km. south of Alpuyeca.

REMARKS.—At our request, Dr. A. Villiers very graciously compared three specimens with the Harold types in the Muséum National d'Histoire Naturelle. He stated that our small Mexican specimen with wide black band and no spots agreed well in size, punctation, form of the clypeus, and frontal carina but that the type had yellow spots. Our larger, many-spotted specimens were reported to be identical in elytral coloration. Because of the poor condition of Harold's types, Dr. Villiers could not be sure of the sex but he indicated he would not be surprised if both Harold specimens were females. Neither has a pronotal projection. Inasmuch as the type male (supposedly!) has a frontal carina and the allotype has both clypeal and frontal carinae, the holotype very likely is a male minor. Because

the many yellowish spots are so typical of *O. arizonensis*, we have concluded that *arizonensis* must be a synonym of *hōpfneri*. *Onthophagus hōpfneri* males vary from very small (3.1 mm.) specimens lacking any trace of the pronotal protuberance but with a very distinct frontal carina, a mere suspicion of an anterior clypeal carina, and few or no round spots in elytral black band, to much larger specimens (6 mm.) with a well-developed conical pronotal protuberance, no head carinae, and numerous round spots on the elytra.

Mexican and more southern specimens seem to be smaller, the yellow part of the elytra is wider anteriorly, the humeral umbone is yellow, there are fewer yellow spots on the median band, the pygidium is black, the pronotal punctures are not quite so deep and clear cut, and each seta is near the anterior of the puncture and at its base has a more evident tubercle. Arizona specimens are usually larger, the yellow base of elytra narrower, the humeral umbone and fifth sutural near base black, the pygidium bicolored.

O. hōpfneri is separated from allied and other United States species by its size and by the color of the elytra, particularly the usually numerous, small, round yellowish spots on the black background across the middle of the elytra. Males usually have a small conical pronotal protuberance, and the elongated foretibiae terminate with a pencil of long hairs and a tooth above the apical spur.

This species has been taken only in south central Arizona. Series of specimens have been examined from Tucson, Patagonia, and the Baboquivari Mountains (particularly Browns Canyon). It seems to be a general dung feeder; the majority of specimens were collected in July and August. Nothing has been recorded on its life history.

Onthophagus arnetti, new species

PLATES 7, FIGURES 68 AND 69; 8, FIGURE 76

HOLOTYPE.—Male major, length 8.6 mm., width 4.8 mm. Head, except clypeus, and pronotum dark green, clypeus and elytra black; finely alutaceous, feebly shining. Clypeus abruptly reflexed anteriorly only, the reflexed portion widely arcuate; disc of clypeus slightly concave, with mixed coarse and fine punctures, slightly rugose laterally; clypeal carina a fine raised line extending from margin to margin; frons slightly convex, moderately punctate, some punctures with erect setae; surface between punctures very finely alutaceous; gena with margin extended laterally further than lateral clypeal margin, obtusely angulate with clypeus; surface of gena coarsely setigerously punctate; eye noticeably convex and nearly twice as wide as eye of either *velutinus* or *browni*; frontal carina obsolete medially; laterally the sharp carina highest at abrupt terminations behind the eyes; surface behind carina with a few coarse setigerous punctures.

Pronotum moderately convex and margined anteriorly and laterally; dorsal surface with distinct tubercles 2 to 3 diameters apart, overhanging minute posterior punctures which bear short fine setae; surface between tubercles alutaceous. Pronotal protuberance forming a wide, shelflike projection over head, the sides of the projection parallel, anterior margin terminating over eyes; broadly emarginate and somewhat depressed medially. When viewed laterally, projection turned slightly upward at apices, with a deep smooth circular fovea under margin on each side, and resembling that of *medorensis*, except that the adjacent fossa is circular instead of elongate; anterior pronotal angles very broadly rounded, much more so than in *O. browni* or *O. velutinus* and not excavated as in *O. medorensis*; posterior angles more abruptly rounded than *browni*.

Elytra with shallow striae, both striae and intervals dull and alutaceous; intervals with two or three irregular rows of small tubercles, small punctures at the base of each tubercle bearing an erect reddish seta. Pygidium feebly convex, completely alutaceous, shallowly, indistinctly punctate, the punctures bearing erect reddish setae.

Ventral surfaces brownish black to black with a faint greenish cast on the legs; antennal club brown to brownish gray. Metasternum with scattered coarse punctures most numerous laterally, each puncture bearing a very long erect seta; midline at center of metasternum largely lacking coarse setigerous punctures but with scattered fine secondary punctures; surface between punctures finely alutaceous laterally. Abdominal segments alutaceous and, except for first segment, with a row of setigerous punctures across their bases. Last abdominal segment emarginate as is typical for the genus in North America. Forelegs not much more elongate than in female, tibia with conical projection over apical spur and with spur sharply bent inwardly near apex. Middle and hind femora with scattered, widely separated, coarse, setigerous punctures and very fine secondary punctures.

MALE MINOR.—Unknown.

ALLOTYPE.—Female, length 6.75, width 4.0 mm. Differing from male holotype in the following respects: Head longer with clypeus not so arcuate laterally or distinctly angulate between clypeus and genae; clypeal margin only narrowly reflexed and weakly emarginate anteriorly; surface of clypeus coarsely, transversely, rugose-punctate throughout; clypeal carina similar but not as fine; frons and genae more coarsely punctate; frontal carina evenly elevated from side to side, curving slightly posteriorly above the eyes. Pronotum convex; pronotal prominence low, rounded, and inconspicuous, slightly arcuate forward over middle third of total width. Forelegs noticeably shorter, the tibia lacking the tooth above the spur. Terminal abdominal segment not narrowed apically to receive the pygidium.

TYPE.—Canadian National Collection 7530.

TYPE LOCALITY.—Pena Blanca Canyon (3800 ft.), Santa Cruz Co., Ariz.

SPECIMENS EXAMINED.—Holotype, allotype, and one paratype.

DISTRIBUTION.—(See fig. 10.)

ARIZONA: Pena Blanca Canyon, Santa Cruz Co. The holotype was collected at black light, July 24, 1960, by Killian Roever, and the allotype by Ross H. Arnett, Jr., July 23, 1959. Paratype, ♂, Patagonia, (E. R. Leach coll., CAS).

REMARKS.—This species is easily separated from other North American *Onthophagus* by the following combination of characters: Dark green head and pronotum with dull black elytra; large convex eyes; small circular pronotal tubercles separated by two or more diameters; short reddish setae at the base of the tubercles on both pronotum and elytra; very broadly rounded anterior angles of the pronotum; the moderately large size, 6.6 to 8.6 mm. in length.

O. velutinus, *O. browni*, and *O. arnetti* are all about the same size, alutaceous and feebly shining, with rather evenly distributed, well-separated tubercles; however, *arnetti* is green and black, *velutinus* dark brown, and *browni* black; the anterior angles are much more broadly rounded in *arnetti*. Viewed laterally, the posterior angles are sharper in *arnetti*, measuring 130° in *arnetti*, 140° in *browni*, and 145° in *velutinus*, and the margin between the anterior and posterior pronotal angles is nearly straight in *arnetti* and noticeably sinuate in the other two; the pronotal protuberance of the female *arnetti* is intermediate in development compared to the others. In *arnetti* the eyes are much

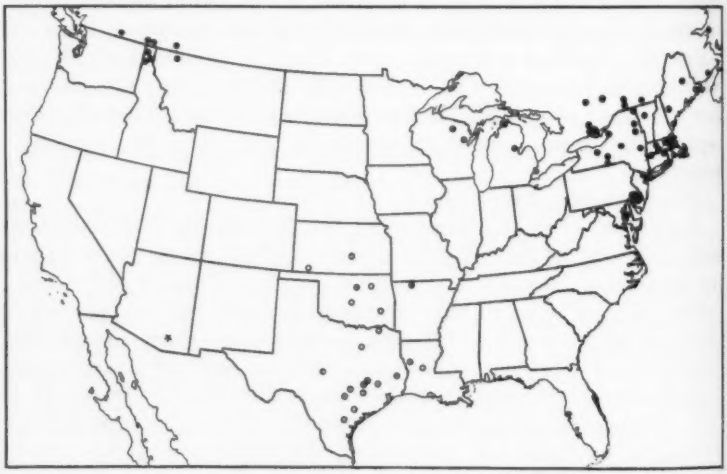

FIGURE 10. Distribution of species of *Onthophagus:*

● *nuchicornis* (Linnaeus) ○ *medorensis* Brown ★ *arnetti*, new species

wider and more convex, being 10 facets wide with a ratio of width to length 7 to 10; in *velutinus* the ratio is 5 to 11, the width 7 facets; in *browni* 4 to 10 ratio, 6 to 7 facets width.

The male major pronotal protuberance is rather similar to that of *O. medorensis*.

Nothing is known about the habits of *arnetti*, the three specimens having been taken at light. However, one might do well to look for *arnetti* in wood rat nests, inasmuch as it is similar to *browni* and *velutinus*, both of which occur in *Neotoma* nests.

We take pleasure in naming this species after its first collector, Dr. Ross H. Arnett, Jr., founder and for many years publisher of the Coleopterists' Bulletin.

Onthophagus browni, new species

PLATE 7, FIGURES 66 AND 67

HOLOTYPE.—Male major, length 6.6 mm., width 3.7 mm. Dorsal surfaces dull black, finely alutaceous between the pronotal tubercles and elytral striae, in these respects being similar to *O. velutinus*. Clypeus reflexed anteriorly and broadly, very shallowly emarginate; disc coarsely, rugosely punctate, delimited posteriorly by a small but distinct, slightly sinuate carina running from margin to margin. Frons, vertex, and gena alutaceous and having scattered coarse punctures which often bear minute reddish setae; carina on vertex indistinct medially, forming a pronounced ridge behind each eye but without any indication of a horn; gena flared laterally by the front of the eye, more noticeably arcuate than in *velutinus*.

Pronotum margined anteriorly and laterally, dorsal surface moderately tuberculate, each tubercle overhanging a small puncture bearing a minute reddish seta, tubercles separated by a distance equal to three or more times their diameter, more crowded anteriorly on the pronotal protuberance; pronotal protuberance flattened, projecting forward as an inverted triangle one-third wider anteriorly than at its base, the strongly sinuate anterior margin broadly shallowly emarginate at middle and curving laterally more sharply posteriorly to the outer angles. A large, deep, smooth, impunctate fossa beneath the protuberance on each side; anterior angles abruptly rounded, lateral margins arcuate, slightly sinuate anteriorly, with a small knob above each margin near the middle. The elytra with smooth, shining, narrow striae; all except sutural interval irregularly, biseriately tuberculate; behind each tubercle a minute puncture bearing a short reddish-yellow seta; surface between tubercles alutaceous. Except for the deeper strial punctures, the elytra almost identical to those of *velutinus*.

Pygidium coarsely punctate, dull and noticeably alutaceous basally, becoming shiny and smooth apically. Ventral surfaces brownish black

with mouth parts, antennal scape, and legs reddish brown to piceous; antennal club grayish black except the apical segment which is tan; ventral parts of the thorax with scattered coarse punctures, each bearing a reddish seta; surface finely alutaceous between punctures except medially on the metasternum where it is smooth and finely punctate; abdominal segments alutaceous and, except for the first segment, with a row of punctures across their bases, most of the punctures bearing short reddish setae; last abdominal segment apically reddish brown, broadly emarginate to receive the pygidium. Forelegs not noticeably larger than those of females, similar to male major of *velutinus* except that they are not as obviously alutaceous on the outer surface. Middle and hind femora with scattered coarse and fine punctures, the coarse ones often bearing setae.

MALE MINOR.—Paratype, length 6.0 mm., width 3.6 mm. Differing from the type in the following respects: Dorsal color reddish black; head similar except that the clypeus is scarcely reflexed anteriorly and the carina of the vertex is higher. Pronotum similar in outline, but less convex and with the pronotal protuberance reduced to a flat shelf barely extending over the back of the head, the protuberance with parallel sides and a truncate anterior margin, the deep fossae on each side of the protuberance in the male major here reduced to shallow indentations with a few tubercles and punctures (in one damaged male minor the thoracic protuberance is so reduced that the pronotum is similar to that described for the female). Elytra, pygidium, and ventral surfaces, except for a lighter color and few more tubercles on the elytral intervals, identical with the male major.

ALLOTYPE.—Female, length 7.0 mm., width 4.2 mm. Differing from the male major in the following respects: Surface of head heavily, rugosely punctate; clypeus scarcely reflexed, more sharply, narrowly emarginate anteriorly; clypeal carina evident and entire from side to side; frontal carina at least twice as high as in male major, bowed posteriorly near the middle. Pronotum differing mainly in the shape of the pronotal protuberance which is reduced to a large median tumosity rising almost vertically above the anterior pronotal margin; a smooth groove on either side of the tumosity representing the fossae of the male major, the anterior edge of the tumosity broadly arcuate and approximately the same width as the carina of the vertex; tubercles of pronotum more pronounced than in male, with the basal setae slightly longer. Elytra similar, except that the tubercles of the intervals appear slightly larger. Pygidium more convex and apically less alutaceous than in male major; ventral surfaces with the setae and punctures more conspicuous; last abdominal segment lighter in color along its posterior margin, not emarginate to receive the pygidium. Foretibia of the same length as in the

male major but broader, with the basal portion of the four outer teeth larger.

VARIATION.—Length ranges from 5.0 to 7.1 mm. and the width from 2.9 to 4.2 mm. Color of individuals varies from reddish brown to completely black. The alutaceous sculpture, tubercles, and setae show little variation except the slight sexual one noted above. The greatest variation other than sexual differences is in size and shape of the pronotal protuberance of the male which ranges from a rounded hump in some male minors to the extensive projection described for the male major.

TYPE.—Canadian National Collection 7531.

TYPE LOCALITY.—1 mile east of Portal, Ariz.

SPECIMENS EXAMINED.—151.

DISTRIBUTION.—(See fig. 7, p. 59.) Holotype and allotype, 1 mi. east of Portal, Ariz., June 26, 1956, H. and A. Howden, in wood rat nest (*Neotoma* sp.). And the following paratypes:

UNITED STATES: ARIZONA: 26 ♂♂, 26 ♀♀, 1 mi. east of Portal, June 26–29, 1956, H. and A. Howden, O. L. Cartwright, F. N. Young (CNC, USNM, Howden, FNY); 1 ♂, 1 ♀, Sept. 14, 1960, H. F. Howden, in *Neotoma* nest (CNC); 10 ♂♂, 15 ♀♀, July 31, 1961, 4 ♀♀, Aug. 1, 1961, in *Neotoma* nest, L. J. Bottimer (LJB); 1 ♀, Southwestern Research Station laboratory, 5 mi. west of Portal, at light, June 28, 1956, H. and A. Howden (Howden); 1 ♂, 1 ♀, Southwestern Research Station, July 12, 1956, R. J. Frederick (RJF); 1 ♀, Southwestern Research Station, Aug. 28, 1958, elevation 5000–6000 ft., H. V. Weems, Jr. (REW); 1 ♀, Southwestern Research Station, July 15, 1961, B. Benesh (BB); 1 ♂, 1 ♀. 1 mi. south of Portal, July 11, 1956, R. J. Frederick (RJF); 1 ♂, 1 ♀, Mt. Graham, July 28, 1954, at light, F. G. Werner (UA); 1 ♀, Mayer, July 1937, E. R. Leach (CAS); 1 ♂, Patagonia, Santa Cruz Co., July 15, 1955, at light, F. G. Werner and G. D. Butler (UA); 1 ♂, Prescott, July 9, 1936, E. R. Leach (CAS); 1 ♀, Mt. Graham, near Safford, July 14, 1956, Vincent D. Roth (REW); 1 ♂, 1 ♀, Chiricahua Mts., July 8, 1952, R. H. Beamer (UKA); 2 ♀♀, July 12, 22, 1953, D. J. and J. N. Knull (OSU); 1 ♀, Ramsey Canyon, July 10–15, 1941, A. Klots (AMNH). NEW MEXICO: 1 ♂, State label only, (H. W. Wenzel coll., OSU). TEXAS: 10 ♂♂, 14 ♀♀, Chisos basin, Big Bend National Pk., May 5, 19, 29, 1959, Howden and Becker, at black light and on carrion (CNC).

MEXICO: CHIHUAHUA: 8 ♂♂, 5 ♀♀, Majalca Rd. (5500 ft.), 30 mi. northwest of Chihuahua, April 17, 1961, wood rat nest, Howden and Martin (CNC, Howden).

REMARKS.—This species can be readily separated from all other United States *Onthophagus* except *velutinus* by the tuberculate pronotum and elytra and the dull black alutaceous surface between the tubercles. The male majors are easily distinguished from *velutinus* by the lack of horns on the head and the odd heart-shaped pronotal projection. Male minors and females of *browni* are sometimes very difficult to separate from females of *velutinus*, being separable only by the shape of the carinae on the head and the larger pronotal hump as noted in the descriptions and in the key. It gives the authors considerable pleasure to name this distinctive species in honor of W. J.

Brown, Entomology Research Institute, Canada Department of Agriculture, Ottawa, who has contributed so much to the study of the genus and who has been of considerable help with the present work.

It seems odd that this species so long escaped discovery. When the present study was started, the only specimen found in any collection was a male in the Canadian National Collection simply labelled "Prescott, Ariz." and determined as undescribed by Mr. Brown. Three other specimens subsequently were collected at light in Arizona by Drs. Werner and Butler, University of Arizona. Then in late June of 1956, when the authors were collecting with Dr. Frank Young near Portal, Ariz., Dr. Young found a dead specimen under a rock at the edge of a wood rat nest. This discovery led to the investigation of several nests in the area, 1 mile east of Portal, and the finding of additional specimens.

Most of the wood rat nests examined were built in the centers of small clumps of mesquite which grew among fair-sized rocks. The rats (*Neotoma* probably *mexicana*) constructed their nests of any material that was handy. In this particular locality the nests consisted largely of mesquite and *Acacia* twigs and bits of cactus. In several nests, dried cow chips were added to the heap, as well as paper, cloth, small rocks, and pieces of broken glass. The nests were 4 to 5 feet in diameter and several feet thick. The rats usually had several entrances to the nest, with the central chamber often under a large rock. It was near the end of an extremely long dry season when the nests were investigated, and the ground crumbled to fine dust when disturbed.

After Dr. Young's initial discovery, the writers chose a large nest and with the aid of an ax and crowbar pulled it apart. The bottom of the nest yielded some fragments and dead specimens of *Onthophagus* and *Euphoria*, but was largely unproductive. It was not until excavation was started beneath the nest that the *Onthophagus* came to light. More than thirty specimens were taken from the one nest in 3 days of digging. Many of the specimens were dead, evidently killed by the prolonged drought. The dusty rocky soil made it very difficult to find the beetles and almost impossible to locate the burrows, for as soon as a rock was removed the soil crumbled to dust. However, one live beetle was found at a depth of 5 inches in what appeared to be a pupal cell beneath the underside of a rock. There was no indication of any dung or other food material.

During the excavating, a few specimens of *O. brevifrons* were also taken, as well as a *Euphoria* near *devulsa* Horn and several species of *Aphodius* and *Ataenius*. Other insects were also numerous.

Several live *O. browni* were taken back to the Southwestern Research Station; one male and three females were placed in a large battery

jar half filled with moist earth and supplied with fresh horse droppings, no fresh wood-rat droppings being available. The beetles were left undisturbed for 12 days before the jar was examined. Four loosely formed cells, 12 mm. long and 6 mm. wide, were found. Two contained eggs; two contained first stage larvae. The two larvae were preserved and the two cells containing eggs were placed in soil-filled 4-oz. metal salve boxes. The eggs hatched in 2 days. The larvae were full grown in 20 to 22 days. One third-stage larva was preserved; the other reached the adult stage on August 5, approximately 30 days after hatching.

The development of *O. browni* seems to conform to the usual pattern for the North American species, but even though the larva seems able to survive on horse dung, unknown factors apparently restrict *O. browni* to pack rat nests.

In September 1960, Howden revisited the Portal locality and excavated additional nests. Only one live pair of *O. browni* was found, but over forty *brevifrons* were taken; these species evidently have different times of activity.

Onthophagus velutinus Horn

PLATE 7, FIGURES 64 AND 65

Onthophagus velutinus Horn, 1875, p. 140.—Austin, 1880, p. 25.—Henshaw, 1885, p. 87.—Schaeffer, 1914, p. 294.—Leng, 1920, p. 248.—Boucomont and Gillet, 1927, p. 208.—Boucomont, 1932, p. 306.—Howden, 1960, p. 460.

MALE MAJORS.—Length 6.2 to 7.0 mm., width 3.5 to 3.8 mm. Dorsal surface dark brownish black to black. Clypeus slightly reflexed anteriorly and broadly shallowly emarginate, each side weakly angulate; disc coarsely, almost rugosely punctate, the surface shining; clypeal carina semi-obsolete, sometimes barely indicated by an impunctate area which is slightly raised medially; frons and vertex with scattered coarse punctures which occasionally bear fine yellowish setae; frontal carina incomplete, represented by two long, nearly straight, usually slightly diverging horns, the horns separated basally by a distance equal to one-third the distance between the eyes; genae extending laterally slightly beyond the arcuate sides of the clypeus, anteriorly delimited from the clypeus by a vague suture which extends posteriorly around the eyes to the base of each horn.

Pronotum moderately convex, margined anteriorly and laterally, the dorsal surface moderately tuberculate, each tubercle overhanging a very small puncture which bears a short yellowish seta; tubercles separated by a distance 2 to 3 times greater than their diameter, becoming smaller and more widely separated posteriorly; surface between tubercles very finely alutaceous and dully shining; pronotum

anteriorly slightly tumid, vaguely concave, and nearly impunctate behind each horn, with the upper median part of the prominence angularly bent forward between the horns; anterior angles rounded, not sharply angulate. Elytral striae shining, the strial punctures barely indicated; intervals, excluding the sutural interval, irregularly biseriately tuberculate, behind each tubercle a minute puncture bearing a small yellow seta; surface between the tubercles finely alutaceous.

Pygidium with scattered, poorly delimited punctures, each bearing a short yellowish seta; surface alutaceous, more so basally, becoming smoother and dully shining apically. Ventral surfaces brownish black to black with mouth parts, antennae, and legs usually reddish brown. Antennal club usually grayish brown, the apical segment largely brown. Ventral portions of the thorax with scattered coarse punctures each bearing a slender, reddish seta; surface between finely alutaceous except medially on the metasternum where it is smooth and impunctate. Abdominal segments alutaceous and, except for the first segment, with a row of vague punctures across their bases, the punctures usually bearing short reddish setae; last abdominal segment reddish brown in color, broadly emarginate to receive the pygidium. Forelegs not noticeably longer than those of the female, the tibia being slightly more slender but not elongated, its flattened outer surface with finely alutaceous sculpture and scattered coarse punctures. Middle and hind femora with scattered coarse punctures bearing short reddish setae.

MALE MINORS.—Length 5.5 mm., width 3 mm. Differing from the male majors in the following respects: Clypeus only slightly reflexed, anteriorly distinctly emarginate with the disc rugosely punctate; punctures more crowded and smaller than in the male major, clypeal carina still vague, but slightly elevated medially; carina of vertex discernible between the lateral horns which are reduced in length and farther apart. Pronotum less convex, the tubercles more widely separated, the anterior tumosity small, indicated by a small arcuate ridge with anterior face tuberculate-punctate and only slightly or not at all concave behind the reduced horns; pronotum anteriorly not extended forward between the horns, anterior angles more angulate. Elytra and pygidium mostly as described for male majors; ventrally the major differences are in the color and the setal length, the ventral color of the male minor being reddish brown, the legs and mouth parts being only slightly lighter, and the ventral setae appearing to be reduced in length. General aspects of the legs appear similar to those of the male major.

FEMALES.—Length 5.4 to 6.1 mm., width 3.4 to 3.9 mm. Differing from the male majors in the following respects: Clypeus scarcely

reflexed anteriorly, shallowly emarginate, with disc rugosely punctate; clypeal carina weak but distinct; frons coarsely punctate; carina of vertex pronounced and fairly uniform in height, nearly straight when viewed from above, not noticeably bent posteriorly at the midline. Pronotum similar to that of male minor except that the pronotal tumosity is less evident, lower, broad, and slightly arcuate. Elytra similar to those of male major. Pygidium differing only in being less convex apically. Ventrally the color of the females ranges from reddish brown to black, with setae shorter than in the male major; punctures of the thorax and abdomen slightly less pronounced, and the last abdominal segment not emarginate or lighter in color; the foretibiae slightly thicker but not shorter than in male majors, and their flattened outer surfaces, while still punctate, only barely alutaceous.

TYPE.—Lectotype, male, present designation, in the Henry Ulke collection, Carnegie Museum, Pittsburgh, Pa. Dr. Horn in his original description stated that *O. velutinus* occurs in Baja California and Arizona. Neither of these localatilities is represented among *velutinus* specimens in the Horn collection at the Philadelphia Academy of Natural Sciences or in the LeConte collection at Harvard College. Banks, Schwarz, and Viereck (1910) stated that some types of LeConte, Horn, and Dietz are in the Henry Ulke collection. In the Ulke collection are two male specimens of the *velutinus* series bearing only the labels "Ariz." and "Cal." These are presumably from the type series; the Arizona specimen is here designated lectotype. Because the fauna of Baja California is different and distinct from that of Arizona, it seems odd that *velutinus* would occur there. Examination shows the "Cal." specimen to be an undescribed species having similar cephalic horns and surface sculpture. It will be described in a subsequent paper.

TYPE LOCALITY.—"Arizona."

SPECIMENS EXAMINED.—89.

DISTRIBUTION.—(See fig. 9, p. 87.)

TEXAS: Big Bend National Pk., Del Rio, Dimmit Co., El Paso, Lake Walk, Sabinal, "S.W. Tex." COLORADO: Canon City. ARIZONA: Base of Pinal Mts., Tucson, Sabino Canyon (Pima Co.), Baboquivari Mts., Florence (Pinal Co.), Globe, San Bernardino Ranch (Cochise Co.), Nogales, Ramsey Canyon (Huachuca Mts.), 36 mi. east of Gila Bend, 10 mi. east of Nogales, 2 mi. east of Lochiel, Carr Canyon.

REMARKS.—Except for three related species, two of which are described in this revision, *O. velutinus* is quite distinct from the other North American *Onthophagus*. The dull black alutaceous dorsal surface and the small scattered tubercles on the pronotum and elytra usually distinguish this southwestern species. The long, erect, slightly diverging, straight horns placed rather close together on the vertex are

unique among our species. These characters will usually separate *velutinus* from the other closely related southwestern species (see p. 100).

O. velutinus ranges from central Texas through Arizona but it is quite rare in collections. Most of the specimens bearing collecting data simply state "collected at light." It apparently has a restricted habitat, probably only in *Neotoma albigula* Hartley nests, a habitat in which it was first collected by L. J. Bottimer. It was taken at black light and in wood rat nests on the lower slopes of the Chisos Mountains (Howden, 1960, p. 460).

Onthophagus concinnus Laporte [5]

PLATE 7, FIGURES 61–63

Onthophagus concinnus Dejean, 1836, p. 157 (nomen nudum).

Ontophagus concinnus Laporte, 1840, p. 87. (This curious misspelling of "*Onthophagus*" is repeated for 39 species, yet the page headings are spelled correctly.)

Onthophagus concinnus (Laporte), Lacordaire, 1856, p. 109.—Gemminger and Harold, 1869, p. 1027.

Onthophagus viridicollis Sturm, 1843, p. 108 (nomen nudum).

Onthophagus protensus Melsheimer, 1845, p. 134 (new synonymy).—Haldeman and LeConte, 1853, p. 54.—Lacordaire, 1856, p. 109.—LeConte, 1863, p. 36.—Gemminger and Harold, 1869, p. 1027.—Crotch, 1874, p. 57.—Boucomont, 1932, p. 329.—Brimley, 1938, p. 200.

Onthophagus subaeneus Horn, 1875, p. 139 (not Palisot de Beauvois, 1811, p. 105).—Blatchley, 1910, p. 919.—Schaeffer, 1914, p. 294.—Leng, 1920, p. 248.—Boucomont and Gillet, 1927, p. 208.—Löding, 1945, p. 99.

MALE MAJORS.—Length 6.8 to 8.1 mm, width 4.0 to 4.4 mm. Head and pronotum usually bright shining green, occasionally becoming violaceous; elytra usually with brownish-yellow basal band and apical spots, medially greenish black, extreme base of elytra and sutural interval blackish. The black area may almost completely cover the elytra, leaving, in extreme cases, only three or four small brownish spots near the basal edge of the elytra, the apical spots being entirely absent. Pygidium usually brownish yellow basally, black apically, but varying from almost completely brownish to entirely black. Clypeus anteriorly sharply reflexed, the anterior margin forming a median flattened perpendicular horn, laterally abruptly rounded, the sides almost parallel and giving the clypeus a rectangular appearance. Disc of clypeus smooth and shining, with a few coarse scattered punctures; laterally becoming rugosely punctate; clypeal carina sometimes semiobsolete, but more often appearing as a fine, sharp, transverse ridge running completely across the posterior clypeal margin; behind the clypeal carina the head medially slightly convex, with scattered coarse setigerous punctures;

[5] *O. concinnus* has been incorrectly credited to the author Castelnau because, as pointed out by Grenier (1952), "Laporte" was the author's name and "Comte de Castelnau" merely his title. In his own writings, Laporte used the abbreviation "Lap." (See Laporte, 1840, 149, "*Trochalus* Lap.")

frontal carina indicated only laterally by a sharp erect horn directed outwardly over each eye; between the horns a median smooth nontuberculate, often finely alutaceous and slightly concave area; genae moderately prominent, their laterally arcuate margins extending slightly beyond the lateral clypeal margins.

Pronotum moderately convex, margined anteriorly and laterally; anterior angles smooth, shining, deeply concave, the fossae extending upward each side to the base of pronotal protuberance which is very similar to that of *O. medorensis* and *O. blatchelyi* and to a moderately developed pronotal process in *O. hecate;* pronotal process broad, slightly wider than the distance between the eyes and extending forward slightly beyond the eyes, its anterior end flared, acutely angled, and deeply emarginated between the hornlike angulations, median edge unarmed. Viewed laterally the dorsal surface of the pronotal protuberance appears almost flat with the tips of the angulations thickened; disc of pronotum evenly tuberculate, the tubercles separated by a distance 2 to 3 times their own diameter, posterior edge of each tubercle with a long reddish-yellow seta, the pronotum therefore having a noticeably hairy appearance. Elytral striae shallowly but distinctly punctate, intervals flat and alutaceous between small shiny tubercles; except on the sutural interval, the tubercles usually arranged in very irregular rows, the interval adjacent to the sutural interval having three or four rows, the next interval two or three, and subsequent intervals usually three rows, each tubercle with a long yellowish seta posteriorly at its base.

Pygidium flat basally, slightly convex over apical half, vaguely alutaceous over basal third, smooth and shiny apically, with coarse punctures most pronounced on apical half, all punctures bearing long yellowish setae. Ventral surfaces generally black with traces of greenish or bluish iridescence, stem of antennal club reddish brown, the club grayish black. Anterior coxae rounded, similarly to *medorensis*, not as transverse as *hecate*, their anterior surface appearing finely rugose. Mesothorax and metathorox coarsely punctate, except along median line of metathorax, each puncture bearing a long, reddish-yellow seta; surface shiny between the punctures, usually not alutaceous as in *medorensis;* metasternum forming a slight ridge between the middle coxae as in *medorensis;* abdomen with a regular line of very small, setigerous punctures running completely across the base of each abdominal segment except the first, last segment slightly emarginate as is typical in the males of the genus. Forelegs elongate, the apical end of the forefemur extending slightly beyond the lateral edge of the thorax; foretibia very long and slightly curved, with an apical conical projection over the tibial spine, the spine thickened and

abruptly recurved at apex. Middle and hind femora with scattered coarse punctures each bearing a long seta.

MALE MINORS.—Length 5.2 to 7.1 mm., width 3.2 to 4.1 mm. Differing from male majors in the following respects: Clypeus rather evenly rounded, reflexed upward only slightly more anteriorly than laterally; disc evenly, rugosely punctate, the punctures bearing short setae; clypeal carina more pronounced than in male majors, but of uniform height and extending completely across the posterior margin of the clypeus. Surface between the clypeal carina and frontal carina as described for the male major; frontal carina evident throughout its length, highest laterally where it forms a small knob at each end; a few scattered, coarse punctures behind the carina; gena scarcely produced.

Pronotum with tubercles and setae as in male major, tubercles almost to the anterior margin; disc generally less convex than in male majors and lacking the identations in the anterior angles; protuberance usually indicated by a slight anterior median swelling. General aspect of elytra and pygidium similar to male major. Except for a slight difference in punctures, the ventral surfaces resemble those described for male majors. Forelegs are shortened, the apices of the anterior femora extending no further than the lateral margins of the thorax, the foretibia proportionately shortened, but still slender and inwardly curved, the apical conical projection lacking. The middle and hind legs slightly more stocky than in male majors, but otherwise similar.

FEMALES.—Length 5.6 to 7.6 mm., width 3.2 to 4.5 mm. Differing from the male majors in the following respects: Clypeus rather evenly rounded, slightly more reflexed anteriorly than laterally with disc very coarsely, rugosely punctate, at least some of the punctures bearing reddish setae; clypeal carina extending completely across the posterior margin of the clypeus, evenly elevated across middle; surface behind the carina coarsely, setigerously punctate, many of the punctures with small indistinct tubercles at basal edges. Frontal carina pronounced, slightly indented medially, and abruptly terminated laterally near the eyes; behind it an irregular double row of setigerous punctures bearing rather pronounced tubercles at their posterior margins.

Pronotum less convex than male majors with tubercles distributed rather evenly over the entire surface, the tubercles usually larger and more pronounced than in males, separated generally by only 1 to 2 diameters; pronotal setae often less conspicuous than in males, somewhat finer; protuberance indicated by a vague hump which is often delimited laterally by a small shiny swelling, the distance between these lateral swellings approximately the same as the length of of the frontal carina of the head. Elytra generally similar to those of

male, but with the tubercles slightly larger and fewer in number, and the setae generally shorter.

Pygidium less convex than in male, otherwise quite similar. Ventral surfaces in general similar to those of male, the coarse setae more scattered; the last abdominal segment of approximately equal length throughout and lacking the characteristic emargination of the male. Legs generally stockier than in male with apex of forefemora not extending to lateral prothoracic margins; foretibiae short and rather stocky without conical projection over the tibial spine, the tibial spine fairly slender and curved inwardly in apical half.

TYPE.—Muséum National d'Histoire Naturelle, Paris.

TYPE LOCALITY.—"Amerique Boreale."

SPECIMENS EXAMINED.—295.

DISTRIBUTION.—(See fig. 7, p. 59.)

ALABAMA: Mobile. FLORIDA: Miami, Monticello, Mossyhead, Newmans Lake (Alachua Co.), Wacissa. GEORGIA: Atlanta, Baker Co., Boston, Fort Valley. LOUISIANA: Covington. MISSISSIPPI: (State label). NEW JERSEY: Blount Springs, Browns Mills, Chatsworth, Hadden Heights, Lakehurst, Malaga, Mt. Misery, Rancocas Park, Riverside, Riverton, Westville. NORTH CAROLINA: Carthage, Southern Pines, West End. PENNSYLVANIA: Broomall. SOUTH CAROLINA: Beaufort, Belton, Coshiers Valley Road (Oconee Co.), CCC Camp 2 (Oconee Co.), Clinton, Columbia, Florence, Fish Hatchery (Oconee Co.), Jocassee, Meredith, Pinnacle Mt., Seabrooks Island, Venus (Pickens Co.), Walhalla, White Pond. TENNESSEE: Black Mts. (Cumberland Co.), Burrville.

REMARKS.—*Onthophagus concinnus* can be separated from closely related species by the shining bright green, rarely purplish, head and pronotum, dark greenish-black elytra with yellowish-brown base and apex, and pronotum with almost circular tubercles separated by more than their own diameters. A few specimens are very hard to distinguish from *O. medorensis* in color and sexual characteristics, but in these specimens the three or more irregular rows of tubercles on the elytral intervals will usually distinguish this species. It can be separated from *O. hecate* and *O. blatchleyi* by the dorsal coloration and the pronotal protuberance of the male major, which lacks downward-projecting median teeth.

Biologically, *O. concinnus* is still somewhat of an enigma. It is a widely distributed species, occurring in the spring and fall from New Jersey to Florida and westward to Mississippi. Nowhere does it seem common. A possible explanation of its seeming rarity may stem from the fact that the adults are usually taken on the droppings of small mammals, skunks, foxes, and possibly others, only occasionally being taken on human feces or cow dung. It has been taken under fungi, under chicken manure, and a few specimens have been collected in fermenting malt traps. Several live females were placed in flower pots and supplied with fresh cow droppings, but none of the specimens

evinced any interest in the dung, dying without attempting to construct brood cells.

As indicated in the synonymy, this species was known for many years under the name *O. subaeneus*, as applied incorrectly by Dr. G. H. Horn, a misidentification mentioned in the remarks concerning that species (p. 76). Melsheimer's name *O. protensus* was resurrected in 1932 by Boucomont who apparently overlooked the earlier name by Laporte. Gemminger and Harold (1869) correctly placed *protensus* as a synonym of *concinnus*. Casey seems to be the only American specialist who correctly identified his specimens as *O. concinnus*.

Onthophagus medorensis Brown

PLATE 8, FIGURES 77 AND 78

Onthophagus medorensis Brown, 1929, p. 204.—Boucomont, 1932, p. 309.—Leng and Mutchler, 1933, p. 38.—Howden, 1955, p. 65.
Onthophagus guatemalensis Schaeffer, 1914, p. 295 (not Bates, 1887, p. 73).—Leng, 1920, p. 249.—Leng and Mutchler, 1933, p. 38.

MALE MAJORS.—Length 6.8 to 8 mm., width 3.9 mm. Purplish black to rather shiny purplish blue to moderately shiny green, the color more pronounced on the head and pronotum. Clypeus anteriorly sharply reflexed, the margin forming a flattened median perpendicular horn; laterally the clypeus sharply rounded, presenting an almost rectangular appearance when viewed from above; disc smooth and shiny with only a few scattered punctures, laterally becoming rugosely punctate; clypeal carina fine but distinct, the fine ridge running completely across from edge to edge; frons slightly convex behind the clypeal carina, the surface finely tuberculate, with a long yellowish seta at the anterior edge of each tubercle. Frontal carina indicated only laterally by a sharp semi-erect, posteriorly directed horn overhanging each eye; medially smooth, nontuberculate, often finely alutaceous between the horns. Genae moderately prominent, their lateral margins extending slightly beyond those of the clypeus.

Pronotum moderately convex, margined anteriorly and laterally; anterior angles shining, smooth, almost impunctate, minutely alutaceous, deeply concave, the fossa extending upward to base of pronotal protuberance. Pronotal protuberance similar to that of *O. concinnus* and male minors of *O. hecate*; the process broad, usually slightly wider than the distance between the eyes, and extending to a position approximately over the eyes, its anterior end slightly flared, acutely angled and strongly emarginate between the hornlike angulations, without a median downward protrusion as in *hecate*; when viewed laterally the protuberance flaring upwards slightly at its anterior tips; pronotal disc evenly tuberculate, the tubercles separated by a distance of approximately twice their diameter, the pronotum with a noticeably

hairy appearance, from the long yellowish seta at posterior edge of each tubercle. Elytral striae black, usually shining, distinctly but not deeply punctate; intervals flat and alutaceous between small, shiny tubercles which are usually arranged in very irregular double rows, except on sutural interval; posteriorly each tubercle with a long, yellowish seta at its base, coloration uniform, no spots being evident in any of the specimens examined.

Pygidium alutaceous and finely punctate over basal half, shiny over slightly convex apical half with rather coarse punctures, all the punctures, both basally and apically, bearing long, yellow setae. Ventral surfaces usually brownish black with only a trace of the dorsal blue or green; stem of antenna dark reddish brown with club grayish brown. Anterior coxae more rounded and not as transverse as in *hecate*, their anterior surface appearing finely rugose. Metathorax laterally coarsely punctate, each puncture bearing a long, reddish-yellow seta, the surface between the punctures finely alutaceous; midline smooth, impunctate, anteriorly forming a vague ridge. Abdomen, excluding the first segment, with a regular line of very small, setigerous punctures running completely across the base of each segment, the last segment emarginate as is typical in males of the genus. Forelegs elongate, the apical end of the forefemur extending slightly beyond the lateral margin of the thorax; foretibia very long and slightly curved with an apical conical projection over the tibial spine, the spine thickened and abruptly recurved at apex. Middle and hind femora with scattered, coarse punctures, each bearing a long seta.

MALE MINORS.—Length 5.5 to 7 mm., width 3.3 to 4 mm. Differing from male majors in the following respects: Clypeus rather evenly rounded, reflexed upward anteriorly only slightly more than laterally; disc evenly, rugosely punctate, with punctures bearing short setae; clypeal carina more pronounced than in male major but of more uniform height and extending completely across the posterior margin of the clypeus; area between the clypeal carina and the frontal carina similar to that described for the male major; frontal carina evident throughout its length, but highest laterally, where it forms a small horn at each end, a few scattered setigerous tubercles behind the carina; genae only very slightly produced laterally, the margins protruding only a short distance beyond the clypeal margin.

Pronotum less convex but with tubercles and setae similar to male major, margin generally similar in outline but without smooth concave area in the anterior angles, the protuberance often indicated by only a slight anterior median swelling, the swelling sometimes delimited laterally by smooth anteriorly directed humps.

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Elytra and pygidium similar to those of male major. Ventrally the metathorax shows fewer coarse punctures; otherwise ventral surfaces resemble those described for male majors. Forelegs shortened, the apices of anterior femora not extending quite as far as lateral margins of thorax; foretibia proportionately shortened but still slender, inwardly curved, and lacking the apical conical projection above the tibial spine. Middle and hind legs slightly more stocky than in male majors but otherwise similar.

FEMALES.—Length 4.9 to 7.7 mm., width 3 to 4 mm. Differing from the male majors in the following respects: Dorsal color of greener blue, often less noticeable; clypeus rather evenly rounded, slightly more reflexed anteriorly than laterally, with disc coarsely rugosely punctate, each puncture bearing a long, thin seta; clypeal carina similar but more pronounced medially, the frons between clypeal and frontal carinae moderately tuberculate, with long, yellowish setae arising from punctures at the anterior base of each tubercle; frontal carina pronounced and at least as high as median portion of clypeal carina, often slightly indented near midline but without any indication of lateral horns, a few setigerous tubercles behind.

Pronotum less convex than in male majors, with shining tubercles distributed quite evenly over the entire surface, the base of each tubercle with a slender, reddish-yellow seta; tubercles slightly larger than those of the male, separated by approximately their own diameter; setae shorter and finer, less conspicuous than in male; pronotal protuberance in some specimens indicated by only a vague hump, in others the lateral edges delimited by a shiny round swelling, the distance between these swellings approximately the same as the length of the frontal carina of the head. Elytra generally similar to those of male, but with the tubercles slightly larger and the setae slightly shorter.

Pygidium slightly less convex than in male but otherwise quite similar. Ventral surfaces generally similar to those in male with the exception of the last abdominal segment which is not emarginate. Legs generally stockier with apex of forefemora not extending to the lateral thoracic margins. Foretibiae not at all elongate, being short and rather stocky with no conical projection over the tibial spine, the tibial spine fairly slender and inwardly curved in apical half.

TYPE.—Canadian National Collection 2971.

TYPE LOCALITY.—Payne County, Okla.

SPECIMENS EXAMINED.—250.

DISTRIBUTION.—(See fig. 10, p. 100.)

ARKANSAS: Boone Co. KANSAS: Liberal, Medora. LOUISIANA: Alexandria, Vowells Mill. OKLAHOMA: Cleveland Co., Latimer Co., Payne Co., Ripley, Stillwater, Tulsa. TEXAS: Bastrop State Pk., Brady, Brazos Co., College Sta-

tion, Colorado Co., Columbus, Lake Corpus Christi State Pk., Dallas, Doncette, Goliad, New Braunfels, Paris, Somerset, Willis.

REMARKS.—This species can be separated from closely related species by the uniform purplish blue or green color and by the hairy tuberculate pronotum with almost circular tubercles separated by a distance usually greater than their diameter. The pronotal protuberance in the male major is also quite distinctive because the apical median portion lacks the downwardly protruding teeth usually characteristic of the male majors of *O. hecate* and *O. blatchleyi*. Also characteristic are the irregular double rows of small tubercles on the elytral intervals and the lack of spots on the elytra. *O. concinnus* is very close but has a bright green head and pronotum and bicolored elytra.

Onthophagus medorensis has been found in some numbers in Oklahoma and eastern Texas. Numerous adults were found in mid-June at Bastrop State Park, Tex., feeding on rotten watermelon rind and on human feces. Most of the specimens were taken in low, well-shaded sandy areas. Several pairs were kept alive, placed in a soil filled 12-inch flower pot on June 16, and supplied with fresh cow dung. On June 26 the flower pot was examined; it yielded a single brood cell 16 mm. long by 10 mm. wide. Near the upper end of the cell was a cavity, 5 mm. in diameter, containing a single yellowish-white egg, 1.8 mm. long, which was attached at one end to the side of the cavity. Subsequent examination on July 5 yielded four more cells at depths ranging from 2 to 5 inches. The cells all contained eggs, one of which hatched on July 9, the first instar exhibiting the prominent conical dorsal wart on the third abdominal segment typical of *Onthophagus* larvae. Unfortunately, in some way eggs of *Aphodius lividus* (Olivier) were included in each of the brood cells and the resulting *Aphodius* larvae destroyed the *Onthophagus* egg or larva in all five cells. This parasitism of the *Onthophagus* brood cells by the *Aphodius* was described in a 1955 paper by Howden. No additional information was obtained concerning the life cycle of *O. medorensis* because all the adults died without having constructed additional broods cells.

Brown (1926; 1928) stated that *O. medorensis* (*guatemalensis*) is abundant during the spring months in Payne County, Okla., beneath excrement in very sandy localities. "It does not occur where there is little or no sand."

Onthophagus hecate hecate (Panzer)

PLATE 8, FIGURES 70–72

Scarabaeus hecate Panzer, 1794, p. 5.—Melsheimer, 1806, p. 3.

Onthophagus hecate (Panzer) Sturm, 1843, p. 107.—Haldeman and LeConte, 1853, p. 54.—Lacordaire, 1856, p. 108.—LeConte, 1863, p. 36.—Gemminger and

Harold, 1869, p. 1030.—Horn, 1875, p. 138.—Austin, 1880, p. 25.—Henshaw, 1885, p. 87.—Blatchley, 1910, p. 918.—Schaeffer, 1914, p. 294.—Leng, 1920, p. 248.—Dawson, 1922, p. 178.—Boucomont and Gillet, 1927, p. 205.—Boucomont, 1932, p. 309.—Lindquist, 1933, p. 120.—Ritcher, 1945, p. 14.—Miller, 1954, p. 380.

Copris hastator Fabricius, 1798, p. 28; 1801, p. 31.

Onthophagus hastator (Fabricius) Lacordaire, 1856, p. 108.—Haldeman and LeConte, 1853, p. 54.—LeConte, 1863, p. 36.—Gemminger and Harold, 1869, p. 1030.—Leng, 1920, p. 248. Boucomont and Gillet, 1927, p. 205.

Copris latebrosus Fabricius, 1801, p. 34.—Palisot de Beauvois, 1809, p. 93.

Onthophagus latebrosus (Fabricius) Sturm, 1826, p. 178; 1843, p. 107.—Dejean, 1836, p. 157.—Kirby, 1837, p. 125.—Melsheimer, 1844, p. 135.—Haldeman and LeConte, 1853, p. 54.—Lacordaire, 1856, p. 108.—LeConte, 1863, p. 36.—Gemminger and Harold, 1869, p. 1030.—Crotch, 1874, p. 57.—Austin, 1880, p. 25.—Leng, 1920, p. 248.—Boucomont and Gillet, 1927, p. 206.

Copris obtectus Palisot de Beauvois, 1805, p. 25.

Onthophagus obtectus (Palisot de Beauvois) Haldeman and LeConte, 1853, p. 54.—Lacordaire, 1856, p. 108.—LeConte, 1863, p. 36.—Gemminger and Harold, 1869, p. 1030.—Leng, 1920, p. 248.—Boucomont and Gillet, 1927, p. 206.

Onthophagus scabricollis Kirby, 1837, p. 126.—Haldeman and LeConte, 1853, p. 54.—Lacordaire, 1856, p. 108.—LeConte, 1863, p. 36.—Crotch, 1874, p. 57.

Onthophagus sayi Laporte, 1840, p. 87.—Lacordaire, 1856, p. 109.—Gemminger and Harold, 1869, p. 1030.—Leng, 1920, p. 248.—Boucomont and Gillet, 1927, p. 206.

Onthophagus furcicollis Dejean, 1836, p. 157.—Gemminger and Harold, 1869, p. 1030.

Onthophagus lama Dejean, 1836, p. 157.—Gemminger and Harold, 1869, p. 1030

MALE MAJORS.—Length 7.5 to 9.5 mm., width 4.2 to 4.9 mm. Black, with occasional aeneous reflections dorsally; appendages brownish black; dorsal surfaces tuberculate, surface between the tubercles opaque, finely alutaceous. Head with median anterior part of clypeus reflexed sharply upward, forming a pronounced, transversely flattened rounded perpendicular horn, surface laterally rugosely punctate, centrally smooth with scattered, fine punctures; clypeal carina indistinct; frontal carina weak, fine, slightly more pronounced laterally; surface of gena and vertex punctate before the carina, impunctate behind the carina. Antenna brownish black with club grayish black.

Pronotum convex, with anterior process usually less than half the width of head, extending forward as far as the posterior margin of the clypeus, narrowest over the posterior carina of head, flaring suddenly, and terminating laterally in two knobs; the anterior margin between the two knobs turning downward and dividing into two small pointed teeth. In many males these central teeth not distinct, but broadly merged with the lateral knobs. When viewed laterally, the dorsal portion of the process forming a straight or slightly concave line with the dorsal curvature of the thorax. Pronotum margined anteriorly

and laterally; dorsal surfaces with pronounced oblong tubercles, usually separated by a distance no greater than their greatest length; behind each tubercle a minute, setigerous puncture; the long, yellowish setae most pronounced laterally and anteriorly, becoming shorter and less obvious medially and posteriorly, almost lacking near the posterior median depression of the pronotal disc. Summits of the tubercles shining, the surface between opaque, finely alutaceous; occasionally a few scattered minute tubercles near the midline; anteriorly on the pronotal process the tubercles irregular, being replaced by punctures at the tip of the process. Elytral striae usually shining, shallowly punctate; elytral intervals, except the sutural, very irregularly triseriately tuberculate; basally each tubercle with a fine, yellowish seta of approximately the same length as those of the thoracic disc; surface between the tubercles finely alutaceous.

Pygidium finely alutaceous over dorsal half, shining and coarsely punctate over lower half. Ventral surfaces of thorax behind the transverse carina shallowly punctate to coxal cavities, the surface between punctures shining and finely ridged. Metasternum medially with a smooth, shining, faint, longitudinal ridge, devoid of punctures and highest anteriorly, laterally setigerously punctate and very finely alutaceous. Each abdominal segment anteriorly with a transverse row of coarse puntures which become more numerous laterally, surface between punctures very finely alutaceous. Legs brownish black; foreleg with femur and tibia longer than in female, the distal end of the femur extending to the lateral margin of the pronotum; tibia with four large lateral teeth with serrate margin between and a conical tooth above the inturned tibial spine; femora of mesothoracic and metathoracic legs with a moderate number of coarse setigerous punctures on their ventral surfaces.

Male minors.—Length 5.2 to 7.9 mm., width 3.0 to 4.5 mm. Usually smaller than male majors or females; differing from the former in the following respects: Clypeus broadly rounded and rather evenly reflexed, only slightly more so anteriorly; clypeal carina pronounced, highest medially; carina of vertex highest laterally, sometimes terminating in a small sharp tubercle; clypeus rugosely punctate, but not as greatly so as in the females. Pronotal protuberance often reduced to a mere hump, similar to that of female; when slightly more pronounced, protuberance as broad as the frontal carina and only slightly emarginate. Two median teeth of the pronotal process becoming apparent only after the process extends well over the head. Foretibia greatly reduced in length, usually not quite as heavy as the foretibia of the female, and lacking the apical conical tooth over the tibial spine. In other respects the male minors are similar to the male majors.

FEMALES.—Length 6.6 to 8.3 mm., width 3.7 to 4.7 mm. The females differ from the male majors in the following respects: Clypeus broadly rounded, only very weakly reflexed, slightly more so anteriorly than laterally; surface strongly rugosely punctate, sparsely setigerous; clypeal carina strong, quite evenly elevated, only slightly higher medially than laterally; setigerously punctate behind the carina, rarely some of the punctures with an accompanying small tubercle; carina of vertex slightly arcuate anteriorly, slightly higher medially with no indication of lateral horn; behind the carina several rows of setigerous punctures followed by an impunctate area; gena not prominent, the margin almost evenly continuous with the clypeal margin. Pronotum less convex than in male major; pronotal protuberance only vaguely indicated by a broad, anterior, median swelling; punctures similar to male, but the setae arising at the base of the punctures often more pronounced, particularly on the disc. Elytra as in male but often with slightly longer setae. Pygidium similar to that of male but not as convex. Legs slightly stockier than those of male, forelegs considerably shorter than in male major, femur not reaching lateral thoracic margin; the tibial spur elongate, gently recurved, not thickened as in male; legs of female otherwise quite similar to those of the male. Last abdominal segment not medially emarginate.

TYPE.—Present location unknown to us.

TYPE LOCALITY.—"America Borealis."

SPECIMENS EXAMINED.—2111.

DISTRIBUTION.—(See fig. 11.)

Taken in Alberta, British Columbia, Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick, and Nova Scotia in Canada, and in every State in the United States except the far western States of Washington, Oregon, California, and Nevada.

REMARKS.—This species may be distinguished from allied species by the sexual characters of the male majors and by the pronounced elongate pronotal tubercles usually separated by a distance less than their own length. The lateral pronotal setae are usually yellowish, and the elytral tubercles, though not as pronounced as those of the pronotum, are still large, each usually with a yellowish basal seta. Dorsal color is ordinarily distinctive, being entirely black with an occasional aeneous glint.

Southward there is a gradual change from typical *O. hecate* to the subspecies described by Brown as *O. blatchleyi*. The pronotal protuberance becomes broader and shorter with less crowded tubercles, the median projection of the protuberance, which in northern specimens terminates in two well-developed separate teeth, develops into a longer binodose process in the specimens from the Carolinas and Florida, and the apical brown spots of the elytra become larger and

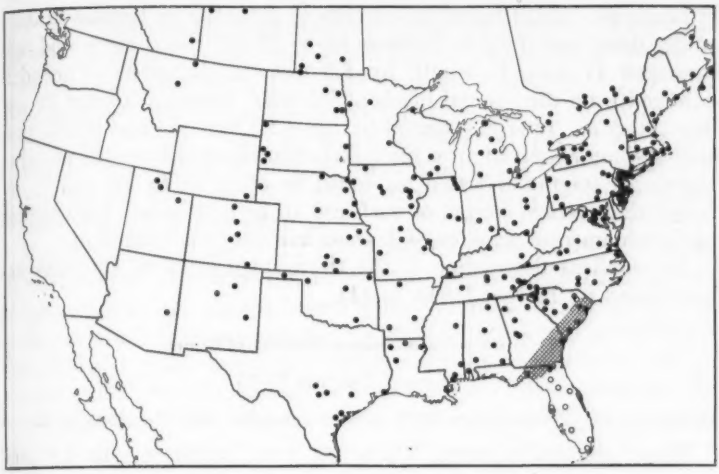

FIGURE 11. Distribution of species of *Onthophagus:*

● *hecate hecate* (Panzer) ○ *hecate blatchleyi* Brown

more numerous in the Florida specimens. Very rarely two or four brown spots occur in northern specimens. Such specimens have been noted from Wisconsin, Michigan, Arkansas, Iowa, Texas, and New Mexico, as well as the southeastern States.

Onthophagous hecate is the most widely distributed and one of the most common of the North American species. As an adult it has been taken under many types of dung, rotting fungi and fruit, at carrion, in bait traps, and at light. Cow droppings seem to be preferred but many specimens have been found on human feces and on droppings from dogs, rabbits, and horses; a few fragments of adults were found also in wood rat nests in the Great Smoky Mountain National Park in Tennessee.

Ritcher (1945, p. 14–15) stated that "at Lexington, Kentucky, adults of *O. hecate* are abundant in fresh cow dung during May, June, and July. They dig tunnels beneath the droppings to a depth of 2 to 9 inches and pack the lower end of each with a wad of dung. Tunnels are nearly vertical for most of their length but each turns near its lower end so that the manure pellet lies nearly horizontally. The farther end of the pellet, at the end of the burrow, is bulbous; the egg is laid in a small cell in the other, neck-like end. When full grown, the larva constructs an elliptical pupal cell within the remains of the old dung pellet." In South Carolina, adults have been taken in every month of the year except January.

Lindquist (1933) found larvel cells of *O. hecate* in Kansas in June under dried cow dung in burrows up to 17 cm. deep; the brood cells averaged 17 mm. in length by 8.5 mm. in diameter. The adult emerged from the "round black pupal cells" between August 25 and September 5. Lindquist stated (p. 120–121) that "a considerable portion of dung remained after the insects transformed from the larval to the pupal stage and would no doubt be of value to the soil." He found the average weight of each cell to be 0.26 grm. Information on developmental time for each stage has not been published.

An excellent description of the third stage larva of *O. hecate* has been given by Ritcher (1945, p. 14).

Onthophagus hecate blatchleyi Brown

PLATE 8, FIGURES 73–75

Onthophagus blatchleyi Brown, 1929, p. 86.—Leng and Mutchler, 1933, p. 38.

MALE MAJORS.—Length 7.5 to 8.5 mm., width 4.3 to 4.8 mm. Dorsal surface with shining tubercles, surface between opaque, finely alutaceous. Color grayish black with a number of brownish spots near elytral apices. Head with anterior portion of clypeus reflexed sharply upwards, forming a horn similar to that described for *hecate;* clypeus rugosely punctate laterally and becoming smooth medially, clypeal carina moderately pronounced; frons noticeably finely alutaceous between the scattered punctures behind the carina, laterally near the eyes the alutaceous sculpture less pronounced; carina of vertex only vaguely indicated, becoming more pronounced laterally but without any indication of lateral horns; gena pronounced as in *O. hecate.*

Pronotum margined anteriorly and laterally, convex. Anterior process extending over the head almost as far as the clypeal carina; the process broad, approximately a third the width of the pronotum, the sides flaring slightly, near the apex forming acute apical angles, with the anterior edge between them directed downward in broad, flattened, apically emarginate horn. Pronotal surface densely tuberculate except for the anterior angles and an area immediately behind and parallel to the anterior pronotal margin. The tubercles ovate, shining, and separated by a distance usually slightly greater than their length; generally less pronounced and separated by a much greater distance than are the tubercles in *O. hecate.* A very short, yellowish seta, much shorter than is usual in *hecate,* at the base of most of the tubercles. Elytral striae shining, intervals with very small, shining tubercles, the surface between finely alutaceous. The tubercles fewer and noticeably smaller than in *hecate* with the setae at their posterior margin almost invisible, those in the interspace between the second

and third striae arranged in a very irregular double row. Two small reddish-brown spots near the elytral apices; an indistinct brownish spot laterally near the middle may be present on each elytron. In some specimens the two apical spots may almost fuse. Pygidium similar to that of *hecate*, but with setae generally shorter. Ventral surfaces and legs similar to those of *hecate*, except for coarse punctures of the thorax and abdomen which are more scattered and bear shorter setae than is usual in *hecate*.

MALE MINORS.—Length 6.2 to 7.8, width 3.8 to 4.3 mm. Similar to male majors in the pronotal tubercles, length of setae, characters of elytra, and position of the brown spots. Variation is most noticeable in the rounded clypeus which is only slightly more reflexed anteriorly than laterally; often the rugose punctures extend entirely across the clypeus with the clypeal carina pronounced. Area between the clypeal carina and the frontal carina similar to that in male major; frontal carina medially weak but pronounced laterally, forming a small denticle at each side. Pronotal protuberance usually merely a broad rounded hump with its anterior lateral edges smooth and shiny. The only other noticeable difference is in the shortened forelegs, the apical end of the femur not extending to the lateral thoracic margin; tibia still slender, but only a little longer than that of the female; tibial spur rather thick and abruptly incurved near its end.

FEMALES.—Length 7 to 8.2 mm., width 4.2 to 5 mm. Differing from male majors in the following respects: Margin of clypeus evenly rounded, slightly reflexed upward, surface coarsely rugosely punctate, many of the punctures bearing short setae; clypeal carina pronounced, slightly higher medially, area between the clypeal carina and frontal carina similar to that described for male; frontal carina somewhat higher than clypeal carina, longer, only slightly higher medially, and lacking lateral denticles noted in the male minors; gena not prominent, its margin almost continuous with that of the clypeus. Pronotal tubercles of females separated by a distance greater than their length, slightly larger than the tubercles in the males and appearing slightly denser; setae arising at the base of the tubercles slightly more evident than in male majors but still very short, particularly on the disc; pronotal protuberance indicated by a vague anterior swelling delimited on each side by a small, rounded shiny hump, the humps separated by a distance approximately equal to the length of the transverse carina of the head.

Pronotum less convex than in the male major, but with outline and margin similar. Elytra in female very similar to those in male, but with tubercles slightly larger, the apical brown spots somewhat smaller and the median, lateral, brown spots often absent. Pygidium

in dorsal half rather flattened and finely alutaceous, the alutaceous sculpture becoming less evident towards the apex which is coarsely, setigerously punctate and quite convex slightly below the median line; not quite as elongate as in the male. Ventrally the female is similar to the male except that the last abdominal segment is not emarginate and the legs are slightly stockier than in the male. The forefemur and tibia considerably shortened compared to the male major, but little shorter than in the male minor; the foretibiae stockier than in either the male major or minor, with the tibial spines rather slender and curved inwardly on outer half.

TYPE.—Canadian National Collection 2870.

TYPE LOCALITY.—Royal Palm Park, Fla.

SPECIMENS EXAMINED.—861.

DISTRIBUTION.—(See fig. 11, p. 119.)

FLORIDA: Capron, Collier Co., Crescent Beach, Donnelton, Dunedin, Enterprise, Estero, Gainesville, Highlands Hammock State Pk., Homestead, Kissimmee River, La Belle, Lake Alfred, Lakeland, Lake Merion, Lake Okeechobee, Levy Co., Lutz, Marineland, Miami, Miami Beach, Ocala, Osceola Co., Orange Co., Paradise Key, Royal Palm Park, Starke, Stemper, Tampa. SOUTH CAROLINA: Beaufort, Charleston, Florence, Hartsville, Yauhannah.

REMARKS.—*O. blatchleyi* has been treated as a subspecies not because it is lacking in distinguishing characteristics, but because all the characteristics in specimens from north of peninsular Florida appear to blend with the true *hecate*. It is interesting that the characters separating *O. blatchleyi* from *O. hecate*, the widely spaced pronotal tubercles, the small elytral tubercles, the brown spots on the elytra, and the broad pronotal horn, all seem to intergrade at approximately the same time and in the same areas. Some investigators have stated that subspecies are often based on only one character and that, if based on more than one, these characters do not show simultaneous intergradation. Here at least is one subspecies that seems to disprove this point. In peninsular Florida south of Gainesville, the populations of *blatchleyi* are uniform and easily distinguishable from the more northern *hecate*. Intergradation begins to occur in a curving line between DeFuniak Springs, Fla., and coastal South Carolina, the areas of intergradation being more diffuse along the coast and more distinct inland. The brown elytral spots are present in some of the specimens taken near Clarksville, Fla., but are entirely absent in any specimens the writers have seen from Mobile, Ala. Likewise, specimens from Savannah, Ga., though having rather small pronotal tubercles, usually lack the brown spots. Hundreds of specimens of *hecate* have been examined, but only relatively rarely have the brown spots been noted in more northern specimens exhibiting the other characters of the true *hecate*.

The subspecies *O. h. blatchleyi* can be separated from other closely related species in the same way as *O. h. hecate* is separated; it is separated from *O. hecate* by the characters discussed above.

No difference has been noted in the habits of *O. h. blatchleyi* and typical *hecate*. The Florida subspecies was collected at cow dung, small animal droppings, decaying fruits, and the fermenting malt-propionic acid mixture. Specimens were taken both in the sandhill areas and in the low hammock areas of south Florida. Some specimens were taken at Paradise Key on raccoon dung.

Despite numerous adult records, the immature stages have not been found.

Onthophagus nuchicornis (Linnaeus)

PLATE 9, FIGURES 81 AND 82

Scarabaeus nuchicornis Linnaeus, 1758, p. 347.—Melsheimer, 1806, p. 3.
Onthophagus nuchicornis (Linnaeus) Curtis, 1825, No. 52.—Henshaw, 1885, p. 87.—Schaeffer, 1914, p. 297.—Leng, 1920, p. 249.—Boucomont and Gillet, 1927, p. 207.—Burmeister, 1930, p. 562.—Boucomont, 1932, p. 318.—Brown 1940, p. 72; 1950, p. 200.—V. Lengerken, 1954. p. 207.—Landin, 1956, p. 7.
Onthophagus rhinoceros Melsheimer, 1846, p. 134.—Lacordaire, 1856, p. 109.—LeConte, 1863, p. 36 (footnote).—Horn, 1875, p. 141.
Onthophagus rhinocerus [sic] (Melsheimer), Haldeman and LeConte 1853, p. 54.
Onthophagus Xiphias? LeConte, 1863, p. 36 (footnote).

MALE MAJORS.—Length 7.3 to 8.1 mm., width 4.4 to 4.7 mm. Head and pronotum black, elytra tan mottled with black, with suture and base black; pygidium, ventral surfaces and appendages black. Head with clypeus slightly reflexed anteriorly, vaguely emarginate; otherwise the outline of clypeus and genae evenly arucate and nearly semicircular. Disc of clypeus shining, very finely punctate anteriorly, becoming moderately punctate laterally and posteriorly; laterally, the punctures elevated anteriorly to form a more or less distinct tubercle, and each bearing short, tan seta; genae similarly punctate. Clypeus and frons separated by a difference in elevation, the frons slightly higher; frons strongly arcuate forward and narrowly smooth along anterior edge, moderately punctate, the punctures more widely separated posteriorly. Vertex armed with a single, very distinctive cylindrical median horn; the horn equal in height to the anterior convexity of the pronotum and broadly flared or transversely flattened basally with an angulation or denticle on each side near basal third of its height.

Pronotum weakly shining, completely margined, poorly so posteriorly, anterior angles rounded; disc moderately convex, slightly tumid anteriorly with a vague shallow, rather broad concavity medially behind the cephalic horn; surface coarsely, shallowly punctate; posteriorly the punctures nearly circular, separated by a distance

approximately equal to their diameter, and with an extremely short seta in the center of each puncture; laterally the setae becoming longer, usually quite evident near the anterior angles; anteriorly the punctures becoming more crowded and raised along their anterior edges, a tuberculate appearance produced; surface between the punctures very finely alutaceous. Elytral striae shallowly punctate; intervals, except for the sutural one, generally irregularly biseriately tuberculate, with a short, tan seta at the base of each tubercle; elytral surfaces weakly shining, finely alutaceous between the striae and tubercles. (Although the amount of black and tan mottling on specimens ranges from largely tan elytra to black elytra with occasional tan spots, there is usually more tan than black.)

Pygidium coarsely, shallowly punctate; each puncture bearing a short, tan setae; surface between the punctures finely alutaceous. Ventral surfaces of thorax coarsely punctate except at impunctate midline of metathorax; most of the punctures bearing long, reddish setae. Abdomen largely impunctate except for a few scattered basal punctures on the last three segments, last segment emarginate to receive the pygidium. Forelegs not elongate, similar to those of female except that the four tibial teeth are more slender; outer surface of foretibia coarsely punctate. Mesothoracic and metathoracic femora with scattered coarse and fine punctures, the coarse ones usually bearing setae.

Male minors.—Length 6.3 mm. to 6.8 mm., width 3.6 to 3.8 mm. Differing from the male majors in the following respects: Clypeus less extended, disc and frons more heavily punctate, the punctures often bearing reddish setae; clypeal carina barely evident as in male major; carina and horn of vertex greatly reduced in height. The carina with a truncated low triangular shape when viewed frontally, the median cylindrical horn barely indicated. Pronotum less convex, barely tumid anteriorly, the tumosity with few punctures and flat but not concave to receive the horn; setae more evident in male minor, being longer on the disc than in the male major. Elytra, pygidium, and ventral surfaces similar to those of male majors.

Females.—Length 6.3 to 8.0 mm., width 3.4 to 4.5 mm. Differing from the male majors as follow: Clypeus less elongate, shallowly emarginate, rather closely punctate, often finely rugose posteriorly; clypeal carina pronounced, arcuate, evenly elevated, and extending the width of the frons; gena delimited from the clypeus by a faint suture, frons behind clypeal carina with scattered, coarse, setigerous punctures; frontal carina very strong, evenly elevated, extending to posterior margin of the eyes; posterior surface of carina with scattered, coarse, setigerous punctures.

Outline of pronotum generally similar to that of male major, but less convex and with a median conical protuberance projecting slightly beyond the anterior margin, occasionally reduced to a poorly defined arcuate ridge but usually well developed and quite similar to the male major pronotal hump in such species as *O. texanus*, *O. subaeneus*, and *O. knausi*; punctures of disc similar to those of male but with the setae occasionally longer and more noticeable. Elytra with tubercles slightly larger but otherwise similar to those of male major. Pygidium less convex than in male, coarsely punctate, smooth surfaces finely alutaceous. Ventral surfaces not differing significantly. Teeth of the prothoracic tibia basally thicker than in the male, in other respects alike in the two sexes. Last abdominal segment not narrowed medially to receive the pygidium.

TYPE.—Collection of the Linnean Society, London (Landin, 1956, p. 7).

TYPE LOCALITY.—Europe.

SPECIMENS EXAMINED.—358.

DISTRIBUTION.—(See fig. 10, p. 100.)

CANADA: ALBERTA: Christina Lake. BRITISH COLUMBIA: Creston, Elko, Marysville, Osoyoos. NEW BRUNSWICK: Grand Manon, Miscow Harbor [sic], St. John. NEWFOUNDLAND: Harmon Field. NOVA SCOTIA: Windsor, Halifax. ONTARIO: Chalk River, Honey Harbor, Irondale, Marmora. QUEBEC: Duparquet, Joliette, Kazabazua, Knowlton, Montreal.

UNITED STATES: CONNECTICUT: Canaan, Pomfret. IDAHO: Granite, Priest Lake (Boumer Co.), Sagle. MAINE: East Machias, Millnocket, Old Orchard, West Bethel. MARYLAND: Ridgely. MASSACHUSETTS: Amherst, Barnstable (Cape Cod), Blue Hill, Boston, Clinton, Forest Hills, Framingham, Ipswich, Milton, Hyannis, North Saugus, Salisbury Beach, Sherborn, Wilbraham, Woods Hole. MICHIGAN: Cheboygan, Douglas Lake, Molasses River, Wilson State Pk. MONTANA: Glacier National Pk. NEW HAMPSHIRE: (State label). NEW JERSEY: Berlin, Camden, Dumont, Gloucester, Reed Beach (Cape May Co.), Riverton. NEW YORK: Albany, Brooklyn, Flatbush, Ithaca, Mt. Hurricane (Essex Co.), Mt. Whiteface, Orient, Plattsburg, Port Gibson, Schroon River, Utica, Waverly, Woodville. PENNSYLVANIA: Broomall. RHODE ISLAND: Providence. VERMONT: Stowe. VIRGINIA: (State label; this seems doubtful). WISCONSIN: Oconto Co., Oneida Co.

REMARKS.—This European species, which has become widely established in North America, may be distinguished from the American species by its moderately large size (6 to 8 mm.), black head and thorax, and brown elytra mottled with black. Dorsally the pronotum is coarsely punctate and finely alutaceous between the punctures. The males can be easily recognized by the presence of a single median horn arising from the vertex.

While little has been recorded on the habits of the species in North America, the life cycle in Europe has been described in detail by Burmeister (1930) and by von Lengerken (1954, pp. 207–235).

In Canada and the United States, the species has been taken at cow and horse dung. It is now established on both the east and west coasts of Canada and the United States, probably by separate introductions. The history of its spread in North America has been discussed by Brown (1940; 1950).

Onthophagus depressus Harold

PLATE 9, FIGURES 79 AND 80

Onthophagus depressus Harold, 1871, p. 116.—Boucomont and Gillet, 1927, p. 165.—Cartwright, 1938, p. 114.—Blackwelder, 1939, p. 50.—Robinson, 1948, p. 177.

This southeast African species has become established in Georgia and Florida. It is quite different from the endemic *Onthophagus* of the United States and, unlike the native species, lacks obvious secondary sexual characters. The external differences distinguishing the male are the emarginate narrowed last abdominal segment and a tibial tooth directed inwards beside the apical spine. Because the secondary sexual characters are few and inconspicuous, the following description includes both sexes.

MALES AND FEMALES.—Length 6.0 to 7.7 mm., width 3.7 to 5.0 mm. Brownish black to black with antennal clubs brown, legs dark reddish brown. Clypeus slightly reflexed anteriorly, sharply, narrowly emarginate, bidentate; disc with elongate transverse tubercles, punctures lacking, surface between tubercles smooth and shining; disc posteriorly delimited from the frons by a vague arcuate carina; genae scarcely flared, surface rough, tubercles irregular; frons nearly flat, tubercles smaller and less elongate than on clypeus, occasional punctures present. Carina of vertex low, often hidden by the anterior pronotal margin; when visible, the carina vaguely depressed and bowed forward medially; area behind the carina smooth and shining. Pronotum completely margined, poorly so posteriorly; anterior angles produced, forming an acute angle bent outward at the tip.

Pronotum convex, more so in large males than in females and diminutive males; surface very closely punctate, the punctures unusual in that they have an elongate flattened tubercle which projects toward their center from the anterior margin and gives the large shallow punctures a crescent shape; anteriorly the pronotum often appearing more tuberculate than punctate, with a short flat stubby seta projecting from each puncture. Superficially the pronotum appears exceedingly rough and granular. Elytra heavily punctate-tuberculate as described for the pronotum, the punctures nearly circular and not as crowded as on the pronotum; elytral striae barely indicated; each interval with two to three rows of flat yellow setae.

Pygidium coarsely, shallowly punctate; each puncture bearing a short, flat, yellow seta, tubercles lacking. Ventral portions of the thorax with scattered coarse punctures, each bearing a long, reddish seta; surface between punctures smooth and shining. Abdominal segments, except for apical one, having across their bases a regular row of coarse punctures; laterally many of the punctures bearing reddish setae. Last segment in male emarginate (narrowed) medially, approximately twice as wide as adjacent segment; last segment in females not narrowed medially, and longer than the combined length of the preceding three segments. Legs similar for both sexes, except for the foretibia of the male which has its inner apical surface prolonged into a spine approximately the length of the first tarsal segment; this projection when seen beside the usual tibial spine, which is present in both sexes, giving the apex of the male tibia an unusual bispinate appearance.

TYPE.—Present location unknown to us.

TYPE LOCALITY.—Caffraria, southeast Africa.

SPECIMENS EXAMINED.—315.

DISTRIBUTION.—(See fig. 4, p. 29.)

GEORGIA: Lyons, Vidalia, Wenona. FLORIDA: Lake Placid, Sebring.

REMARKS.—This species can be separated from other North American *Onthophagus* by the sharply emarginate, bidentate, transversely tuberculate clypeus. The rough appearance of the pronotum, the crescent-shaped punctures with the flat anterior tubercle, and the short, stubby, yellow setae all serve to distinguish the species. Also characteristic is the bispinous apical end of the male foretibia and extremely wide last abdominal segment of the female.

The species is a dung feeder. An extensive series of specimens was collected in the vicinity of Lyons, Ga., on cow dung and at light by the late P. W. Fattig.

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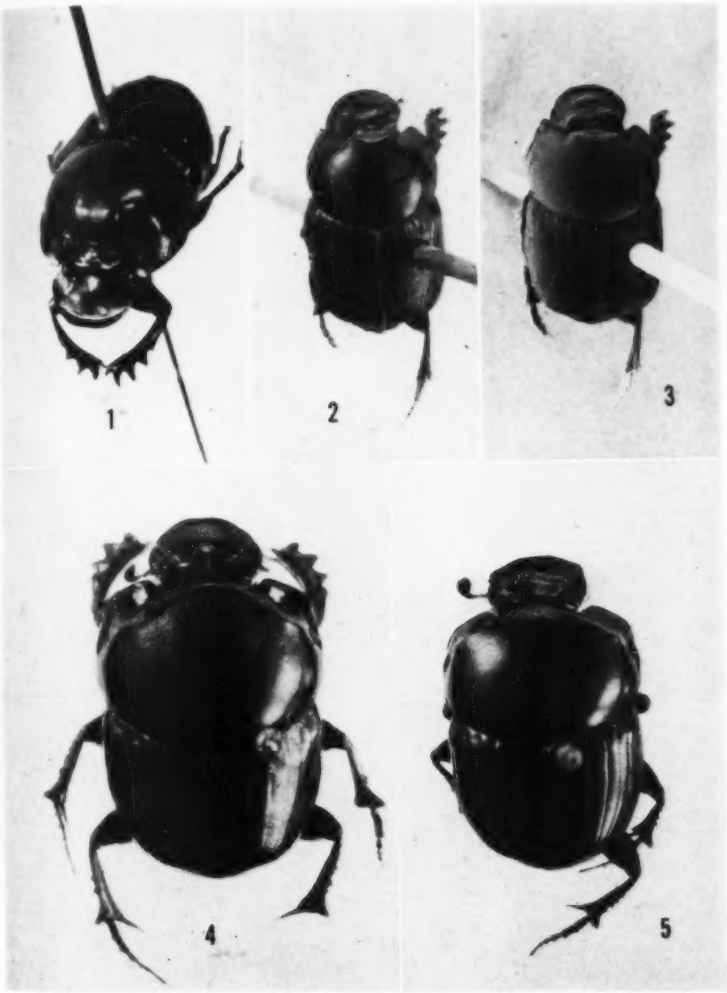
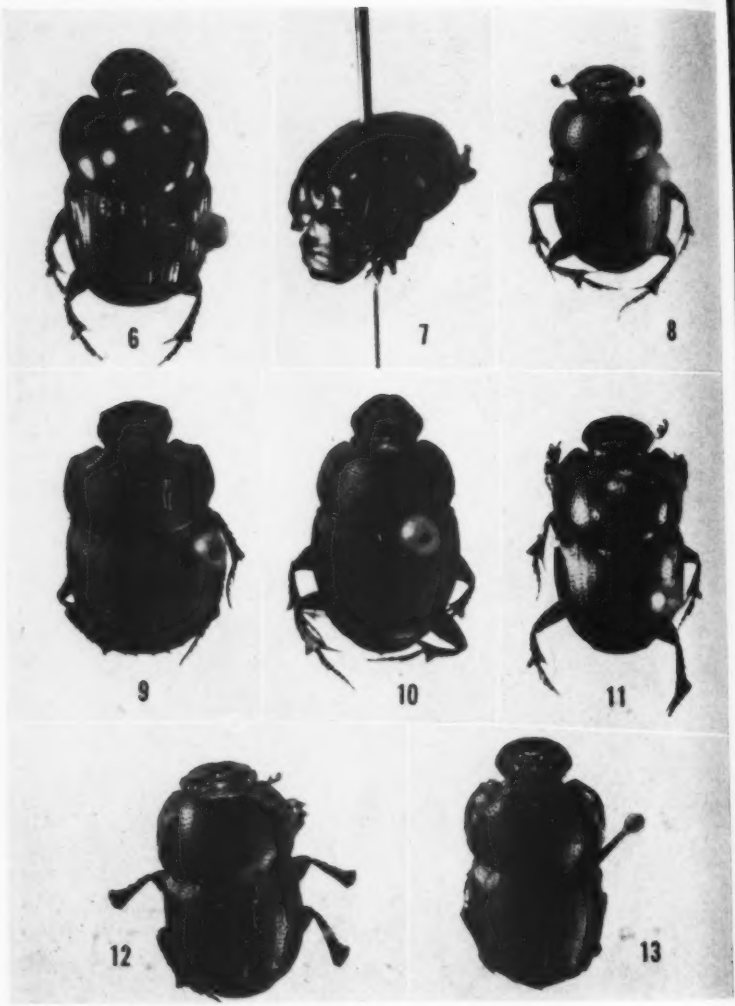
U.S. GOVERNMENT PRINTING OFFICE: 1962

Plates

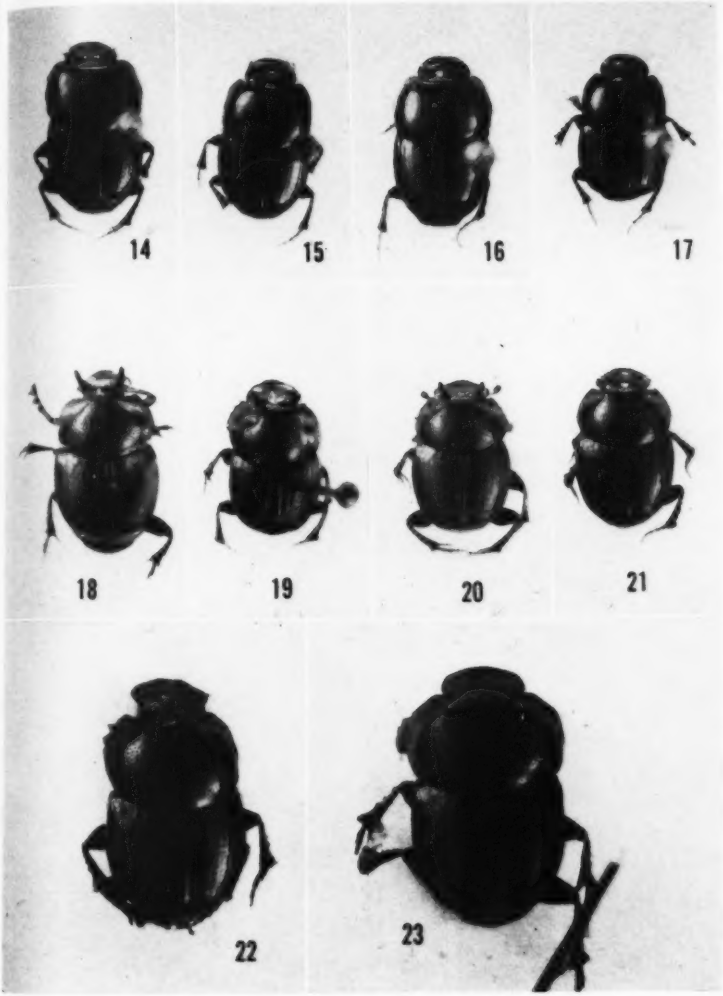
(With plate figures 1–84)



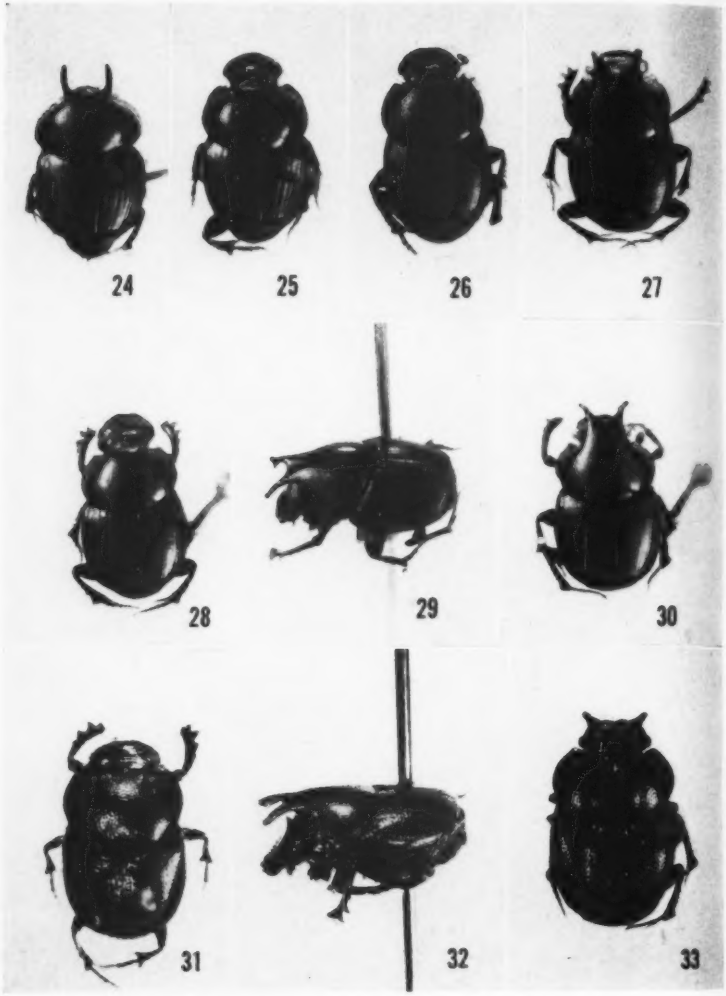
1–3, *Onthophagus incensus* Say: 1, ♂; 2, ♀ (holotype); 3, ♀ (holotype smoked to show cephalic carinae). 4, 5, *O. coproides* Horn: 4, ♀; 5, ♂.



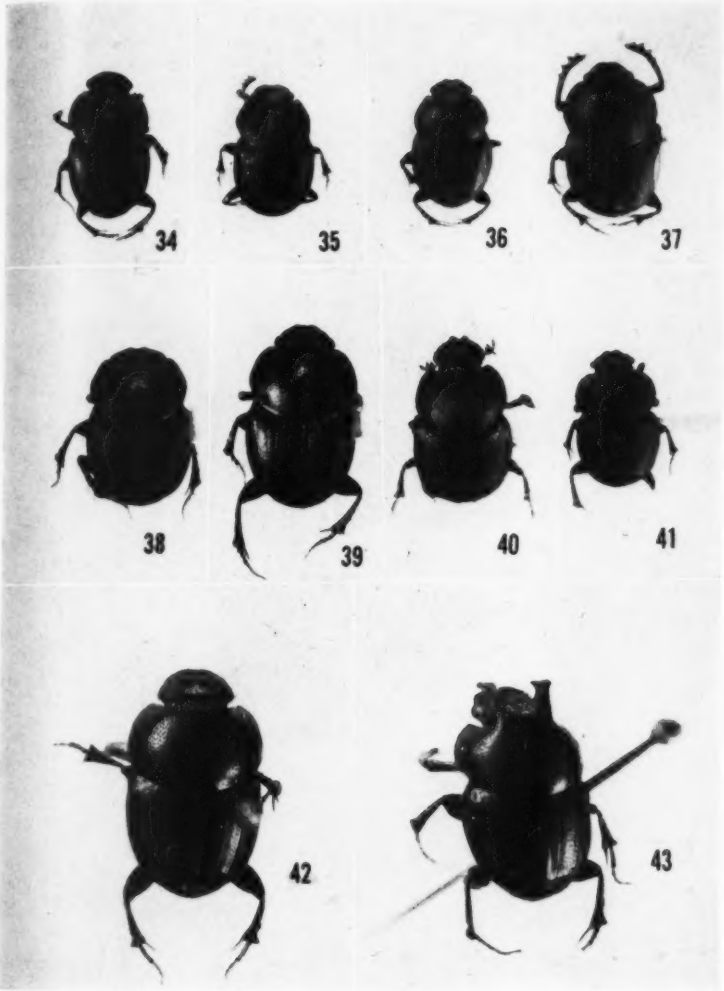
6, 7, *Onthophagus batesi*, new species: 6, ♀; 7, ♂. 8, *O. subtropicus*, new species: ♀. 9, 10, *O. cochisus* Brown: 9, ♂; 10, ♀. 11, *O. subtropicus*, new species: ♂ (holotype). 12, 13, *O. brevifrons* Horn: 12, ♀; 13, ♂.



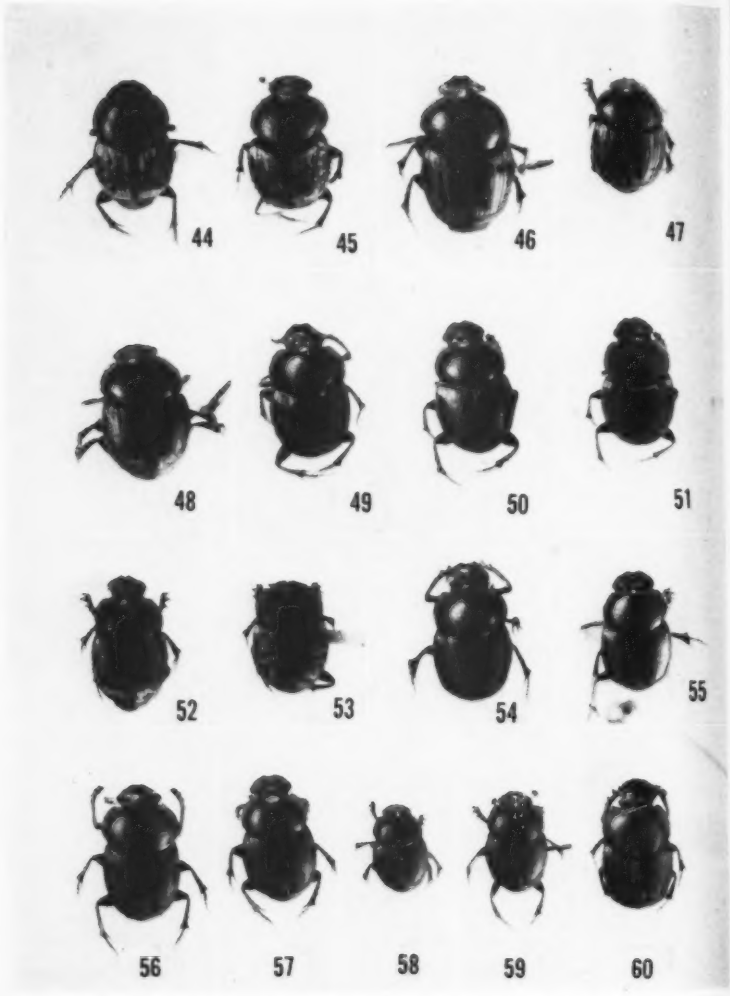
14, 15, *Onthophagus polyphemi polyphemi* Hubbard: 14, ♂; 15, ♀. 16, 17, *O. polyphemi sparsisetosus*, new subspecies: 16, ♂; 17, ♀. 18–21, *O. striatulus striatulus* (Palisot de Beauvois): 18, ♂; 19, ♂; 20, ♂; 21, ♀. 22, 23, *O. cavernicollis*, new species: 22, ♀; 23, ♂.



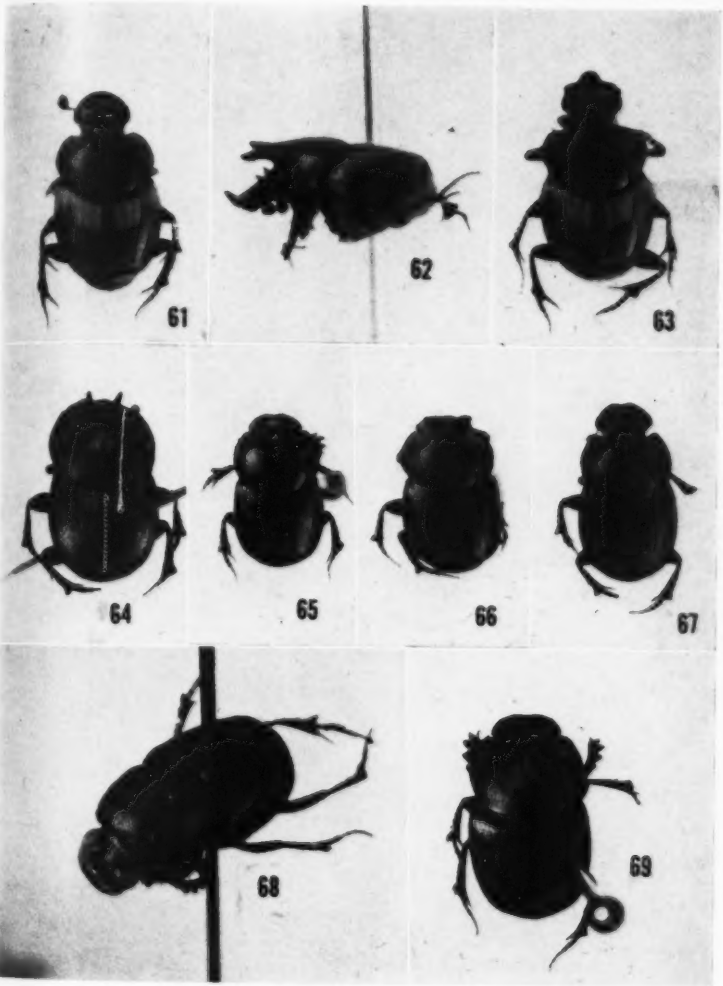
24, 25, *Onthophagus striatulus floridanus* Blatchley: 24, ♂; 25, ♀. 26, 27, *O. orpheus orpheus* (Panzer): 26, ♀; 27, ♂. 28–30, *O. orpheus canadensis* (Fabricius): 28, ♀; 29, ♂; 30, ♂. 31–33, *O. orpheus pseudorpheus*, new subspecies: 31, ♀; 32, ♂; 33, ♂.



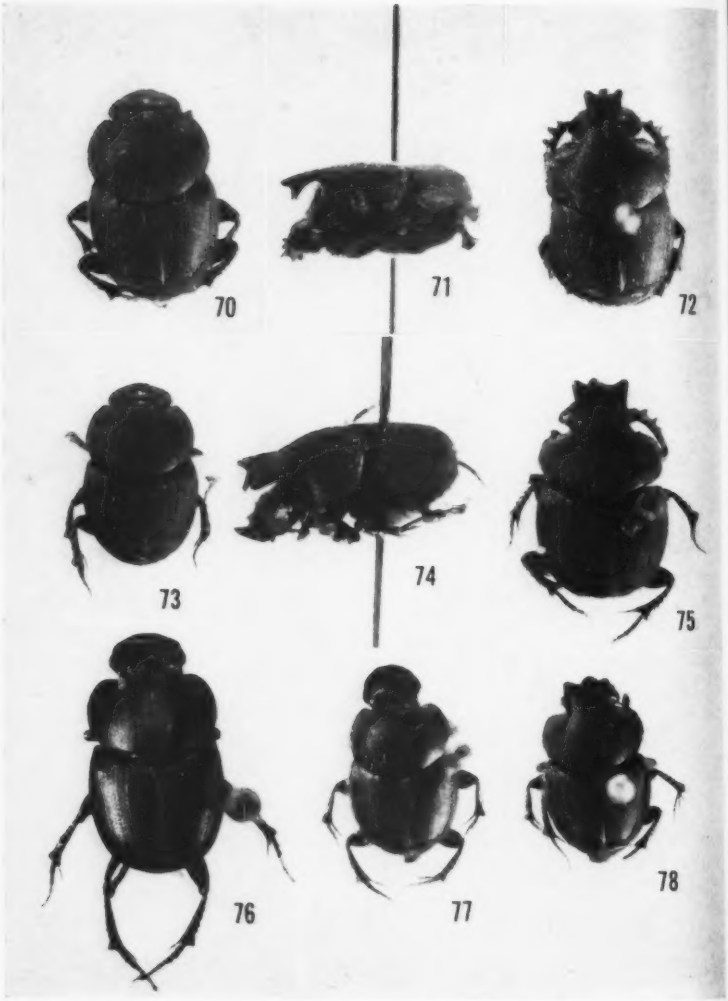
34, 35, *Onthophagus knulli*, new species: 34, ♂; 35, ♀. 36, 37, *O. alluvius*, new species: 36, ♀; 37, ♂. 38, 39, *O. monticolus*, new species: 38, ♀; 39, ♂. 40, 41, *O. subopacus* Robinson: 40, ♀; 41, ♂. 42, 43, *O. cynomysi* Brown: 42, ♀; 43, ♂.



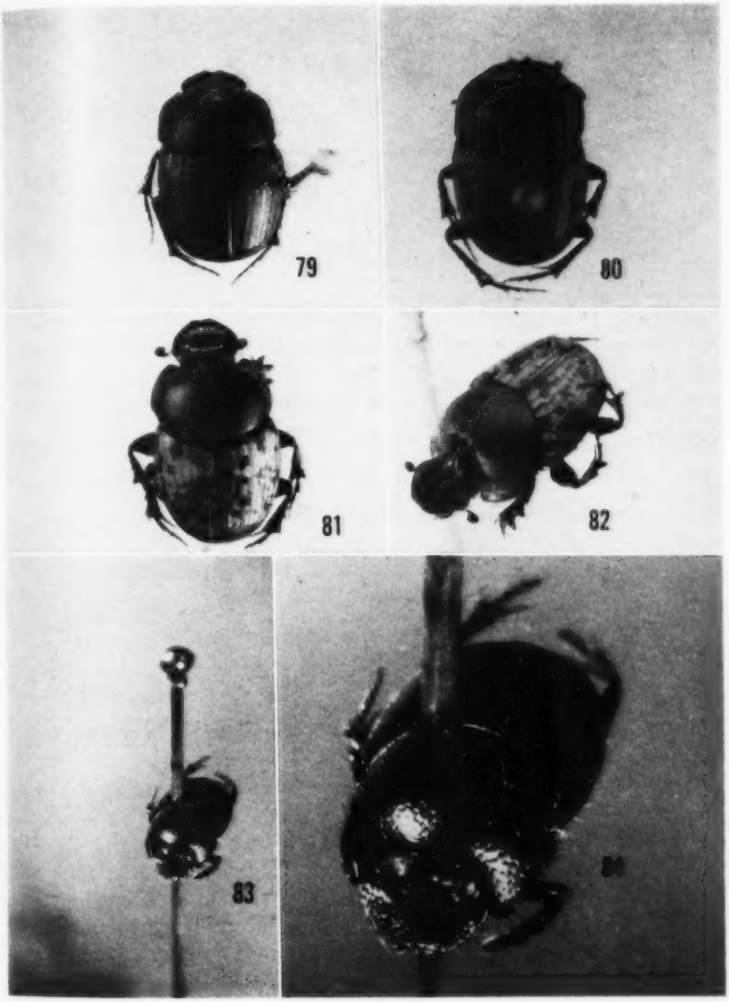
44, 45, *Onthophagus höpfneri* Harold: 44, ♂; 45, ♀. 46–48, *O. landolti texanus* Schaeffer: 46, ♂; 47, ♀; 48, ♀. 49–51, *O. schaefferi*, new species: 49, ♂; 50, ♀; 51, ♀. 52, 53, *O. tuberculifrons* Harold: 52, ♀; 53, ♂. 54, 55, *O. subaeneus* (Palisot de Beauvois): 54, ♂; 55, ♀. 56, 57, *O. knausi* Brown: 56, ♂; 57, ♀. 58, *O. oklahomensis* Brown, ♀. 59, 60, *O. pennsylvanicus* Harold: 59, ♀; 60, ♂.



61-63, *Onthophagus concinnus* Laporte: 61, ♀; 62, ♂; 63, ♂. 64, 65, *O. velutinus* Horn: 64, ♂; 65, ♀. 66, 67, *O. browni*, new species: 66, ♂; 67, ♀. 68, 69, *O. arnetti*, new species: 68, ♂; 69, ♀.



70–72, *Onthophagus hecate hecate* (Panzer): 70, ♀; 71, ♂; 72, ♂. 73–75, *O. hecate blatchleyi* Brown: 73, ♀; 74, ♂; 75, ♂. 76, *O. arnetti*, new species: ♂. 77, 78, *O. medorensis* Brown: 77, ♀; 78, ♂.



79, 80, *Onthophagus depressus* Harold: 79, ♀; 80, ♂. 81, 82, *O. nuchicornis* (Linnaeus): 81, ♀; 82, ♂. 83, 84, *O. aciculatulus* Blatchley: 83, ♂; 84, ♂ (enlarged to show cephalic tubercles).

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NEW SPECIES OF SPIDER WASPS, GENUS AUPLOPUS, FROM THE AMERICAS SOUTH OF THE UNITED STATES (HYMENOPTERA : PSAMMOCHARIDAE)

By R. R. Dreisbach

Introduction

This paper is divided into two parts, the first covering Mexico, Central America, and the Caribbean region, and the second part South America. Keys for the species of each region follow this introduction.

Cameron[1] lists 28 Mexican and Central American species for this group under the genus *Pseudagenia* Kohl. Since this paper was published at a time when the species were placed in only a few genera, it is impossible to know from his paper which species belong in the genus *Auplopus* Spinola (which replaces *Pseudagenia* Kohl).

This problem was solved for the writer by Dr. H. K. Townes in his trip to the British Museum to study the types of Ichneumonidae. He checked Cameron's types and placed them in the correct genus according to present-day knowledge. He was well qualified for this as he had just recently published on this group for the North American fauna. His investigation reduced the 28 species listed by Cameron to 13 species for the genus *Auplopus* Spinola. This paper

[1] Biologia Centrali-Americana, Hymenoptera, 1892, pp. 161–173.

incorporates in the keys these 13 species as well as 6 more described by Banks, Cresson, and Smith for the same region.

The remainder of the species belong in the following genera according to present-day classification:

Ageniella: *championi* Cameron (Pseudagenia), *collina* Cameron (Pseudagenia), *levipes* Cresson (Pompilus), *tolteca* Cameron (Pseudagenia), *utilis* Cameron (Pseudagenia)
Allochares: *azurea* Cresson (Pompilus, Agenia)
Calicurgus: *calcaratus* Cresson (Pompilus, Agenia), *teapae* Smith (Salius)
Dipogon: *isthmica* Cameron (Pseudagenia), *melanocephala* Cameron (Pseudagenia), *nubifer* Cresson (Pompilus)
Priocnemella: *caerulipes* Smith (Agenia), *tabascoensis* Cameron (Pseudagenia)
Priocnessus: *cincticornis* Cresson (Priocnemis), *orbiculata* Smith (Agenia)
Priophanes: *azteca* Cameron (Pseudagenia)

Banks [2] reported 17 South American species of this genus in his key and papers, and there are two of Fox's types in the Carnegie Museum in Pittsburgh which belong here. One of Bank's species, *auricoma*, has an entirely different type of subgenital plate and genitalia from the other species and is not included in this paper; it probably should be placed in a new genus, as I have seen no other genitalia or subgenital plate of its type. Twenty-five species are described as new in the present paper, thus making 43 species from South America in this genus.

The species *magdalenus*, which I had tentatively placed in *Auplopus*, does not belong here, as it has two basal hooklets at inside base of volsellae; the genitalia is also distinctly different, as can be seen from the photomicrographs in figures 52 and 53. It is therefore placed in the genus *Ageniella*.

The male of *A. coerulosoma* (Banks) was never described. There is a male with this name at the American Museum of Natural History in New York City. The specimen is not available at present so could not be placed in the key. The photomicrographs of genitalia and subgenital plate are shown in figures 60, 61.

The symbols used for location of types represents the following collections:

AMNH: American Museum of Natural History, New York City
Cal.: State Department of Agriculture, Sacramento, Calif.
Cal. Acad. Sci.: California Academy of Sciences, Golden Gate Park, San Francisco Calif.
RRD: R. R. Dreisbach, Midland, Mich.
MCZ: Museum of Comparative Zoology, Cambridge, Mass.
Munich Mus.: Zoologisches Staatssammlung, Munchen, Germany
Townes: Henry K. Townes, Ann Arbor, Mich.
USNM: U.S. National Museum, Washington, D.C.

[2] South American Psammocharidae, Bull. Mus. Comp. Zool., vol. 96, no. 4, pt. 1, 1946.

Genus *Auplopus*

In the writer's classification of the Psammocharidae, the genus *Auplopus* Spinola belongs in the subfamily Macromerinae.

FEMALES.—The basal segment of abdomen narrows in front to form a petiole and then enlarges a little as it joins the propodeum; this makes this petiole cancave in the middle on each side, hour-glass shaped (when seen in profile from above); a distinct group of long, forward-curving bristles on mentum; the clypeus generally very characteristic, the apex in middle extending forward slightly beyond the margins on each side, and the lower edge of clypeus raised somewhat above mouth; last dorsal segment of abdomen with an elliptical pygidium which in majority of cases is smooth and shining, only in a few species is it mat and rather opaque; no spines on dorsal surface of posterior tibiae; propodeum is hairy above; first tergite without a line separating off the epipleuron; second ventral segment with a transverse groove near base; claws with a tooth.

MALES.—Subgenital plate with a high, sharp longitudinal ridge at least on apical fourth; the base of plate (generally telescoped under preceding sternite) almost always with an elevated flat-surfaced triangular area which extends varying distances toward apex before the triangle becomes closed and the ridge becomes thin and sharp; parapenial lobes apically decurved to form a hook; parameres generally rather large and broad, but may be somewhat slender; in either case almost always with a sharp ridge on dorsal edge; aedeagus shorter than volsellae or parapenial lobes, rather broad, parallel-sided or convex on sides, generally rounded at apex but sometimes slightly emarginate at apex; there are no basal hooklets on the inside and at the base of the volsellae either in the species considered in this paper or in the species recorded under *Auplopus* by Townes [3], some extralimital species which have been placed in this genus have double basal hooklets. These are placed in other genera by the writer. The absence of basal hooklets at base of volsellae is another character which separates the genus *Auplopus* from *Ageniella* as the latter has double basal hooklets instead of no hooklets. *Auplopus* has a small flap which projects outward from base of volsellae, larger and broader than hooklets and obtuse at apex instead of acute. The basal hooklets are always in front of the volsellae in other genera and also generally project downward. The groove that extends from base of rear wings to the middle coxae on side of thorax has a small pit about apical third just above it; a groove extends from this pit to the posterior coxae, it is evident and rather strong (which separates this genus rather well from *Ageniella* in the males, as it is obsolete or

[3] Nearctic wasps of the subfamilies Pepsinae and Ceropalinae, U.S. Nat. Mus. Bull. 209, pp. 143-167, 1957.

hardly visible in *Ageniella*); in many species the last tergite is wholly white or has a white spot in the middle.

In both sexes the third cubital cell is longer and broader than the second and extends nearer apex of wing than the marginal cell; the basal vein in forewings is basad of the transverse vein by about the length of the latter; in rear wings the subdiscoidal vein is generally basad of cubitus but it is sometimes interstitial; lateral ocelli are from 1.0 to 2.0 as far from eyes as they are from each other; eyes are lenticular and are almost parallel on inner edge (concave in some species); posterior orbits and temples very narrow; anterior ocellus almost always slightly larger than the laterals; propodeum is almost flat, hardly any declivity; in both sexes the claws have a small sharp tooth near middle which extends at right angles from claw.

I. MEXICAN, CENTRAL AMERICAN, AND CARIBBEAN SPECIES

(Species 1–56)

Key to Species from Mexico, Central America, and the Caribbean

FEMALES

1. Abdomen wholly rufous 2
   Abdomen not rufous 3
2. Head black, thorax greenish, antennae brownish, no white or rufous marks on head or thorax; forefemora and foretibiae yellow; middle and rear femora yellow, the middle tibiae yellow beneath, the dorsal surface light colored, violet tinted; all tarsi and posterior tibiae blackish; coxae and trochanters black, with greenish reflection, strongly sericeous; wings hyaline, veins brown; propodeum slightly striated in apical half; third antennal joint longer than fourth; pronotum strongly sericeous on dorsal surface; length about 9.0 mm. Panama . . . . **1. shannoni,** new species
   Head black with clypeus, cheeks, anterior orbits and fore part of head underneath, light yellow; pronotum reddish; head and thorax strongly golden pubescent; all parts of legs including coxae yellow, except posterior tarsi is darker colored; third antennal joint much longer than fourth; front part of forewing from costal margin to back of cubital cells much darker colored than the rear half of forewing or the rear wing; antennae yellow, browner on dorsal surface; length about 11.0 mm. Trinidad.
   2. semialatus, new species
3. Pygidial area mat, not polished and shining; depression of pronotum with cross-wrinkles; front trochanter entirely fulvous; dull black without iridescence; wings hyaline; apex of mandible ferruginous; legs beyond coxae fulvous except apical tarsal joints; spurs brown; length about 11 mm. U.S., Mexico, Central America (and *A. mexicanus* var. *floridus* Cresson). **mexicanus** (Cresson)
   Pygidial area polished and shining (or if not eyes converging below see couplet 46) 4
4. Golden pubescence on head and thorax, or also on abdomen or only dense golden pile on face 5
   No golden pile on body anywhere 10

5. Head, thorax, and abdomen covered with dense golden pile; that on abdomen more sericeous and not so dense; mandibles, clypeus (except a streak in middle), inner orbits, and narrow posterior border of pronotum, golden; antennae yellowish but dorsal surface browner; coxae (except at base, apex and part of dorsal surface), all femora (except a posterior stripe), all tibiae, and tarsi, except apical joint of first two pairs and all of posterior pair, light yellow; wings fulvous with veins and stigma yellow; posterior border of first five tergites reddish, and almost all of sixth; thorax almost black; length a little less than 9.0 mm. Costa Rica, Mexico.

auripilus (Cresson)

Only head and thorax with dense golden pubescence; abdomen if slightly golden, pronotum golden 6

6. Pronotum and rest of thorax greenish, pronotum not marked with reddish or yellow; abdomen silvery or without pubescence 7

Pronotum mostly black, or completely bright golden thorax either black or slightly greenish 8

7. Coxae green on dorsal surface, reddish on ventral surface; all rest of legs (except four apical tarsal joints) reddish; head and thorax with appressed golden pubescence, as well as upright light-colored hair, but hair on front and vertex dark; thorax a shining green; mandibles, the apex of the rounded clypeus, the dorsal surface of first three antennal joints, and the underside of the first four antennal joints (rest blackish) reddish yellow; wings dusky, the veins and stigma yellow; coxae mostly rufous beneath and greenish dorsally; propodeum slightly ridged on apical half (extending to the sides); abdomen shining blackish; basal veins in forewings, and subdiscoidal and cubital veins in rear wings much disjointed; length about 8.5 mm. Panama . . . . . **3. splendens,** new species

Coxae, trochanters, and apical joints of tarsi black; rest of legs reddish; posterior margin of pronotum arcuate; wings almost hyaline, tinged with yellowish or fuscous; antennae with at least four or five basal joints yellowish; length, 8–12 mm. 9

8. Pronotum completely golden; thorax slightly greenish on dorsum more evident on sides of thorax; posterior margin of pronotum angulate; legs completely reddish (including coxae and trochanters) except apices of tarsi; the pubescence of clypeus and cheeks is much denser, brighter and more clearly separated from rest of head; mandibles are reddish fulvous; wings more yellow; first recurrent vein received by the second cubital cell in middle; length 12 mm. Panama . . . . . **curvinervis** (Cameron)

Pronotum black with posterior edge and lower sides yellowish; posterior margin transverse; no greenish on thorax; first tergite with a reddish line across posterior margin; tergites two, three, and four with the posterior edge reddish, color band straight on sides and forming a triangle in center with apex pointing forward; the last two tergites and the last three ventral segments completely reddish; coxae and trochanters yellowish with some black; mandibles all yellow except extreme tips are black; length about 14.5 mm. Mexico, Brazil . . . . . **princeps** (Banks)

9. Antennae testaceous dusky at tip; base of femora black; wings hyaline, somewhat suffused with fuscous, stigma black; head wider than thorax; third joint antennae about one quarter longer than the fourth; abdomen shining; pygidium shining impunctate; coxae bearing a dense golden pubescence; longer spur of hind tibiae not reaching middle of metatarsal joint; the second and third cubital cells about equal at top; female. Mexico, Guatemala . . . . . **cressoni** (Cameron)

First four or five joints antennae reddish the rest black; base of femora reddish; wings hyaline, tinged with reddish. Mexico . . **subvirescens** (Cresson)

10. At least some of legs rufous 11
Legs all black or bluish 46

11. Coxae, trochanters and body black, at least posterior femora rufous (abdomen may have faint violaceous reflection) 12
Coxae, trochanters, and body not all black 18

12. Forelegs and middle legs completely black, only posterior femora reddish, their knees black; head and mesonotum finely punctured; abdomen shining impunctate 13
Middle and posterior legs both at least partly rufous 14

13. Eyes distinctly converging below; a smooth shining, finely transversely striated band at base of propodeum; apical segment of abdomen shining, bearing some scattered punctures, apex testaceous; apical joints of antennae brownish beneath; length 9. mm. Panama . . . . **gentilis** (Cameron)
Eyes distinctly converging above, ratio of lower to upper interocular distance is 18:16; no smooth shining, finely striated band at base of propodeum; apical segment of abdomen, shining; without punctures, apex slightly testaceous; apical joints of antennae hardly brownish beneath; length 12 mm. Costa Rica, Trinidad, Brazil, British Guiana . . **comparatus** (Smith)

14. Forelegs completely black, middle and hind femora except base and apex reddish; clypeus, lower face, lower thorax and apical part of propodeum densely white pubescent; head, thorax above, and propodeum with long pale hair; all coxae hairy; basal and transverse veins in forewings nearly interstitial and subdiscoidal in rear wings interstitial with the cubital vein; Barro Colorado Island, Costa Rica . . . . . **esmeraldus** (Banks)
Forefemora partly or wholly reddish 15

15. Forefemora mostly black, only inside and apex reddish; wings hyaline, veins yellowish; ratio of third and fourth antennal joints is 16:14, third joint equal to vertex width; length 9.0 mm. Canal Zone . **50. dietzi,** new species
Forefemora completely rufous (forefemora may be black at base); wings hyaline, veins black 16

16. Only femora rufous, all tibiae and tarsi deep black, as is the body; antennae with a narrow yellow band beneath from joints 6 to tip, black above; ratio of lengths of third and fourth antennal joints is 19:12; about same length as preceding but a heavier insect; length 11.0 mm. Barro Colorado Island. **4. femur-rubrus,** new species
All femora completely rufous; head and thorax dull black, abdomen shining black 17

17. Foretibiae and basitarsi of forelegs yellow, last two pairs tibiae and their tarsi all dark; antennae yellowish beneath, black above; ratio of length of third and fourth antennal joints is 17:14; length 11.2 mm. Barro Colorado Island . . . . . **23. nigriculus,** new species
All tibiae and basal joint of all tarsi yellow; antennae only very slightly yellowish on apical joints beneath, black above; ratio of lengths of third and fourth antennal joints is 15:12; length 10–11 mm. Mexico. **49. fulgidus,** new species

18. Trochanters red (at least some of them), coxae black or only forecoxae black or coxae partly fuscous 19
Trochanters and coxae black or some shade of blue or green or some yellowish but mostly dark-colored 26

19. Only forecoxae black, rest of legs all reddish except apical tarsal joints; head, thorax, and abdomen black; clypeus, face, sides of pronotum, sides of

thorax, and propodeum shining pubescent; antennae black; wings dark brown; length about 7.0 mm. Costa Rica, Mexico . **17. incognitus** (Smith)

All coxae dark-colored. 20

20. All coxae dark-colored but with the ventral surface and apex yellowish, the rest with a bluish tinge; all legs reddish except last joint of tarsi of first two pairs of legs and last four joints of posterior legs; antennae wholly reddish; whole body with a coarse slightly yellowish pubescence; head, thorax, and abdomen with a faint greenish tinge; wings yellowish, with yellow veins and stigma; length 10.5 mm. Costa Rica.

5. villosus, new species

Coxae not as above, and without the somewhat yellowish coarse pubescence, wings not yellowish 21

21. All coxae dark-colored with apex yellowish 22

Coxae not with yellowish apex 23

22. All basitarsi bright yellowish, coxae almost black but with a slight bluish tinge; legs colored as in *villosus;* antennae dark brown on top, lighter colored beneath; body with normal prostrate white pubescence on head and thorax; abdomen shinging, pruinose; head and thorax slightly greenish; wings with slightly dark veins and stigma blackish; length 10.5 mm. Barro Colorado Island. . . . . **iolanthe** (Banks)

Posterior basitarsi dark-colored, the first two pairs very dark reddish; all legs with a much darker cast than in *helvolus* (where the legs are bright yellow); abdomen black with a trace of bluish, where the pruinose vestitute is rubbed off; head almost black, just barely a trace of greenish; thorax very dull greenish, with violet reflections; face, clypeus, and parts of thorax (sides) with dull, scant, whitish pubescence; the apex of propodeum with long, dense, shaggy, prostrate, white pubescence across apical third; coxae with greenish reflection; veins of wings black; first recurrent vein meets second cubital cell beyond middle; length about 10.0 mm. Costa Rica.

6. nebulosus, new species

23. Antennae black, or black above and yellowish below; or first joint of antennae is yellow below and yellow above with a black stripe and all tibiae and basal joints of all tarsi are yellow 24

Antennae with first joint bright yellow above and below; coxae not black on dorsal surface, blue or blue green; legs bright yellow; thorax with yellowish (slightly golden), prostrate pubescence; thorax greenish, hidden in places by the dense somewhat coarse pubescence; first antennal joint bright yellow above and below, the next two dark reddish above, yellow below, the rest dark; size smaller, length 8.0 mm. Barro Colorado Island.

8. minus, new species

24. Face, clypeus, and inner orbits black; front and vertex with a faint dull greenish tinge; thorax hardly with more color than head or may be plainly greenish; clypeus, face, and inner orbits with appressed silvery pubescence; anterior trochanters yellowish or mostly black, last two pairs mostly black; abdomen black, shining; interior orbits with a faint narrow yellowish streak just above antennae or rarely with none; all femora bright yellow as well as foretibiae; midtibiae darker on apex and on inside, posterior tibiae all dark; forebasitarsi yellowish, rest of foretarsi and the other two pairs dark; thorax with more or less silvery pubescence all over; ratio of lengths of third and fourth antennal joints is 18:14; length 12.0 mm. Barro Colorado Island, Guatemala . . . . . **24. lineatus,** new species

Head not black, abdomen black or reflecting colors; no yellowish on anterior orbits; tibiae all yellow or some dark 25

25. Antennae black above, slightly yellowish below at base; head bluish with purple reflection, dull, thorax greenish, abdomen with blue purple reflection, dull; clypeus, face, and thorax with fine, prostrate, silver pubescence; trochanters, femora, tibiae, and basitarsi of forelegs reddish yellow; middle and posterior tibiae dark; ratio of length of third and fourth antennal joints is 14:11; length 11.0 mm. Panama . . . . . **7. opacus,** new species

Antennae all black; face and clypeus black, front and vertex dull greenish; pronotum, sides of thorax and from postscutellum to apex of propodeum more or less bright greenish, especially the latter; the mesonotum and scutellum black; abdomen black; face and clypeus with some silvery pubescence, the thorax with less and with a rather rough appearance with considerable long light-colored hair; only the forepair of trochanters yellow, the rest black; all femora, foretibiae, and forebasitarsi reddish yellow, rest dark; antenna lost beyond third joint, length third joint 20 (same scale as ratios in previous couplets); length 11.9 mm. Costa Rica. **25. quartus,** new species

26. Coxae and trochanters dark, bluish; femora (except at apex) and apical joint of tarsi black; tibiae and tarsi yellowish, spurs blackish, yellowish at base, and the posterior spur not reaching middle of metatarsal joint; eyes with a distinct curve, converging a little at bottom; cheeks and clypeus covered with dense silvery pubescence; pronotum angulate on posterior border; abdomen shining; apical tergite shining, impunctate; antennae black, pruinose; first recurrent received in middle of second cubital cell, the second in basal third of third cubital cell; wings almost hyaline; length 12 mm. Mexico . . . . . **montivagus** (Cameron)

Coxae and trochanters not bluish, or if so, legs not colored as above; at least last two pairs femora reddish 27

27. Abdomen black or with only the faintest trace of reflected colors (if in doubt consider abdomen black); at least metatarsal joint of foretarsi yellowish. 28

Abdomen not black but with very noticeable reflected colors 32

28. Basal half to three quarters of forefemora and base of last two pairs, black; metatarsal joint of middle legs also reddish yellow; larger species, legs in particular thicker and longer; trochanters black, not yellowish at tip, the black continuing onto the base of femora; antennae brown dorsally, yellow ventrally; pubescence coarser, and or longer; length about 9.0 mm.; head and mesonotum finely punctured; wings brownish, veins black; posterior tibiae slightly reddish beneath. Mexico, Panama . . **9. zetcki,** new species

All femora wholly rufous 29

29. Foretarsi with only basal joint obscurely yellowish beneath; antennae blackish 30

Foretarsi almost completely bright yellow; antennae bright yellow beneath, brown above; last two pairs tarsi in certain reflected light completely dark, in other light basal joint slightly dark reddish; sides of thorax as well as dorsal surface a bright shining green, with no trace of blue or violet color; wings hyaline, veins slightly yellowish in reflected light; length about 6.5 mm. Panama . . . . . **10. panamensis,** new species

30. Posterior tibiae black, or with a dark reddish cast in which case the tibiae appears black compared to the bright yellow femora and first two pairs of tibiae; antennae brown and yellowish beneath 31

Posterior tibiae rufous as well as the other tibiae and femora; middle and posterior metatarsal joints rufous beneath; antennae dark; sides of thorax and propodeum with a definite bluish and violet coloration; wings hyaline,

slightly brownish in reflected light, veins brown; length about 8.0 mm. Costa Rica . . . . . **11. sapphirus,** new species

31. Posterior tibiae dark reddish appearing black compared to the bright yellow femora and first two pairs tibiae; femora all completely rufous; color of legs bright yellow; abdomen black, shining, pruinose, with very faint bluish reflection; head and thorax dull greenish; clypeus and face with rather strong appressed silvery pubescence; head and thorax with no long hair, a smooth appearance; wings hyaline, shining and brown; trochanters yellowish at tip and slightly on ventral surface; length a little over 7.0 mm. Panama . . . . . **12 exilis,** new species

Posterior tibiae black, the femora and first two pairs tibiae reddish; abdomen black, not shining, not pruinose, without bluish reflection; face and clypeus much more heavily silvery sericeous; wings hyaline, veins yellow; trochanters all black; head and thorax with long whitish hair, a rough appearance; length 8.2 mm. Guatemala . . . . **55. hispidus,** new species

32. None of tibiae rufous, femora all rufous but knees of last two pairs dark; clypeus black, head with shades of blue and purple, thorax with similar colors; abdomen black in certain light, but with brilliant shining blue and purple; antennae brownish beneath, black above; wings hyaline; clypeus 2.0 as broad as long; upper interocular distance (17) slightly less than lower; head as long as broad; ratio of length of third and fourth antennal joints is 16:12; length 10.2 mm. Barro Colorado Island.

26. venetus, new species

At least foretibiae rufous 33

33. Only the foretibiae rufous 34

The first two pairs of tibiae rufous 39

34. Antennae black; head and thorax dull green or blue 35

Antennae yellowish below, black dorsally, if hardly yellow below insect less than 7.0 mm. in length; antennae with the joints cylindrical 36

35. Antennae black; head and thorax dull green with strong blue and violet reflections; abdomen strongly bluish and violet; a dull rather coarse sericeous pubescence on clypeus, face, and thorax; base of all femora blackish at base and rear pair at apex; tarsi all black; a large coarse species; femora enlarged, the forefemora more than a fourth as wide as long, ratio of lengths of forefemora and tibiae is 38:30; ratio of lengths of third and fourth antennal joints is 19:13: lateral ocelli 1.5 as far from eyes as each other; wings with a violet iridescence; joints of antennae with the apex larger than base of next joint, giving an appearance of knots; length 12.5 mm. Panama.

14. grossus, new species

Head and thorax dull green without blue and violet reflections; abdomen not quite with as brilliant purple and violet reflection; all femora yellowish no black at base or tip; foretibiae reddish yellow rest black; forebasitarsi reddish rest of tarsi all black; forefemora one fifth as wide as long; ratio of length of forefemora to tibiae is 39:34; ratio of lengths of third and fourth antennal joints is 22:17; wings hyaline, slightly yellowish, shining in reflected light not violaceous; joints of antennae cylindrical not larger at apex of joints than the base of next joint; length 12.0 mm. Costa Rica . . . . . **28. magnus,** new species

36. At least clypeus, face and inner orbits to above antennae black, whole head may be black 37

Clypeus and face not black 38

37. Clypeus, face, and inner orbits to above antennae, black; front and vertex blue green; pronotum, mesonotum, and sides of thorax blue green, the sides

especially with beautiful purple shades; the sides and dorsum of propodeum purple with bluish reflection; scutellum and postscutellum black; coxae violet, trochanters dark suffused with yellow; femora and foretibiae yellow; middle and posterior tibiae and all tarsi black; abdomen violet colored; ratio of length of third and fourth antennal joints is 9:8; length 6.0 mm. Canal Zone . . . . . **27. minusculus,** new species

The whole head black; the whole thorax green, with no purple iridescence, abdomen black in certain light with brilliant blue reflection with a trace of purple; clypeus and face with mostly blackish pubescence, scant; thorax with considerable upright hair, especially on propodeum, and fairly well covered all over with fine pubescence which only shows up in reflected light; coxae blue, trochanters dark, all femora and foretibiae reddish; the mid-tibiae strongly reddish beneath but dark dorsally, as are all the rest of legs; the posterior tibiae with violaceous reflection in certain light; ratio of lengths of third and fourth antennal joints is 13:10; length 8.6 mm. Panama . . . . . **29. callainus,** new species

38. Clypeus with a greenish cast, face, front and vertex, the latter two with vague purple reflection; the whole thorax, including scutellum, postscutellum and propodeum, bright green (and blue) with strong purple reflection; coxae black with green reflection, trochanters black; the femora all yellow with basal third (forefemora) or basal fourth black; anterior tibiae yellow, last two pairs and all tarsi black; abdomen black with blue reflection; ratio of length of third and fourth antennal joints is 15:13; length 9.0 mm. Panama . . . . . **13. carinus,** new species

Middle of clypeus black, rest of head and thorax bright blue green, without purple reflection; coxae blue green, trochanters black, yellowish beneath; femora with first two pairs black at base last pair at base and apex; clypeus apex of mandibles and mouth parts yellowish; ratio of lengths of third and fourth antennal joints is 16:13; length 6.6 mm. West Indies. **30. buscki,** new species

39. Apical half of mandibles, and mouth parts bright yellow; antennae yellow underneath, brown dorsally; abdomen violet; thorax and head greenish with bright violet and purplish reflection; middle and posterior tarsi and posterior tibiae brownish; eyes slightly converging above, upper ocular distance about 0.9 the lower; lateral ocelli only just slightly nearer each other than to eyes; ratio of third and fourth antennal joints is as 14:10; length 8.0 mm. Nicaragua . . . . . **21. blatteus,** new species

Apical half of mandibles and mouth parts blackish 40

40. Thorax almost black, especially on dorsal surface (except a greenish streak between mesonotum and scutellum), where the middle on mesonotum has a purplish streak in center (paratype without streak); sides of thorax have some bright green in thoracic pleural sutures (paratype without the green), but plates of thorax dull purplish colored; the whole thorax rather dull, opaque, and with a hairy appearance; wings with greenish reflections; wings hyaline, veins brown; abdomen violaceous, shining, pruinose; foretarsi yellow except three apical joints; posterior tibiae a deep reddish brown; antennae yellow beneath, brown above; length 8.0 mm. Cuba, Nicaragua . . . . . **16. aquilus,** new species

Thorax not black, with very noticeable green or bluish color 41

41. Basal tarsal joint of foretarsi black; first two pairs tibiae and all femora reddish; posterior tibiae and all tarsi black, middle tibiae blackish on dorsal surface; head and thorax obscurely green with rather coarse, prostrate, pubescence; coxae and trochanters black with greenish tint; antennae

black; wings dusky with black veins and stigma; legs more reddish than the following; abdomen reflecting purple; length 8.6 mm. Guatemala.

15. guatemalensis, new species

Basal joint of foretarsi yellow, but not as bright colored as rest of legs; either with antennae black and abdomen black (a definite violet tinge) or antennae strongly yellowish beneath 42

42. Antennae black and abdomen almost black (slightly violet in certain light); foretibiae yellowish, the middle one definitely yellow in certain light but dark-colored in other reflection; basal joint of foretarsi yellow, rest of joints of foretarsi and all joints of last two pairs dark; wings hyaline, veins and stigma dark; ratio of length of third and fourth antennal joints is 11:8; eyes deeply concave on inner orbits but upper and lower interocular distance equal, 14 on same scale as antennal measurement; lateral ocelli 1.3 as far from eyes as each other; length 8.0 mm. Barro Colorado Island.

18. olivarus, new species

Antennae yellowish on basal half or more underneath and abdomen strongly purple or bluish 43

43. With a very prominent white streak on lower inner orbits; antennae yellow underneath whole length, brown dorsally, the last four joints much flattened and distorted; ratio of length of third and fourth antennal joints is 16:13, the comparable vertex width 16; lower interocular distance is 16; head light green, thorax about same shade of green but with violet reflection, especially on propodeum; abdomen strongly violaceous, shining; all tibiae red in certain light but last two pairs darker in other light; dorsal surface of posterior tibiae dark reddish in reflected light; wings yellowish, veins and stigma bright yellow; length 9.3 mm. Trinidad.

20. violaceus, new species

With a hardly noticeable very short, narrow yellowish streak on inner orbits just above antennae, or with none; antennae yellow below on basal half or more; no violet reflections on thorax; dorsal surface of posterior tibiae not dull reddish; wings hyaline, veins and stigma dark 44

44. With a hardly noticeable narrow, short streak on inner orbits just above antennae on interior orbits; ratio of length of third and fourth joints is 14:11, the comparable vertex width is 16; the lower interocular distance is 15; abdomen more bluish, shining; first two pairs tibiae bright yellow, posterior pair much darker, not yellowish, but with a strong purple cast in reflected light; coxae blue green, trochanters dark with a blue-green reflection; foretarsi dark reddish much darker than tibiae; middle and posterior tibiae dark but with a reddish cast in reflected light; wings hyaline, no trace of yellow, veins and stigma dark; length 8.5 mm. Barro Colorado Island . . . . . **19. purpureus,** new species

No yellowish streak on anterior orbits; face and clypeus with silvery, sericeous pile; propodeum rugulose; thorax densely punctured 45

45. Metallic green with blue reflections on pleura and propodeum; silvery across apex of propodeum; legs fulvoferruginous; coxae blue green; trochanters, tarsi, and apex of posterior tibiae blackish, violaceous; wing hyaline, dusky at tip, iridescent and with a faintly yellowish gloss; abdomen smooth and shining varied with a silvery sericeous pile; head densely punctured; antennae pale brown, yellowish at base underneath; length 8.0 mm. Mexico . . . . . **chloris** (Cresson)

Dull green with purplish reflections on pleura and propodeum; head dull green with stronger purplish reflections; propodeum no more silvery across apex than elsewhere; coxae mostly black, less bluish green re-

flection; trochanters black; only foretibiae and midtibiae yellow; last three joints anterior tarsi and all of other pair dark; all posterior tibiae black, not violaceous; wings hyaline hardly dusky at tip, violaceous in reflected light; abdomen black in certain light, brilliant blue and violet in other light, pruinose; head more aciculate than punctured; antennae yellow beneath, brown above; upper interocular distance (17) slightly less than lower; ratio of third and fourth antennal joints is 11:11; length 8.0 mm. Mexico . . . . . **22. roseus,** new species

46. Body black, antennae black; wings fuscous 47
At least thorax strongly some shade of green or blue 49

47. Pygidium mat, not shining; body dull black, opaque; eyes distinctly converging above; lateral ocelli 1.7 as far from eyes as from each other; clypeus, cheeks, and head not with silvery pubescence; length 8.5 mm. Panama. **obscurus** (Banks)
Pygidium shining, impunctate 48

48. Eyes distinctly converging below; clypeus and cheeks densely covered with silvery pubescence and long black hairs; lateral ocelli twice as far from eyes as from each other; thorax covered with long pale fulvous hair which is especially long on sternum; first recurrent vein received beyond middle of second cubital cell; length 9.0 mm. Mexico . . . . **perditus** Cameron
Eyes not converging below, upper and lower interocular distances about equal; clypeus and cheeks with little silvery hair and with short white hairs; lateral ocelli not quite twice as far from eyes as from each other; thorax with only a very little short white hair on either dorsal or ventral surface; first recurrent vein received by the second cubital cell in the middle; length 6.7 mm. Bermuda . . . . . **56. bermudensis,** new species

49. Head and abdomen black, thorax bluish green with very strong purple reflection over almost whole surface; head and thorax with medium length light hair; antennae black, slender; coxae shining black, with faint bluish reflection; legs beyond coxae black, with faint bluish reflection, but apices of tarsi more brownish; abdomen black shining, pruinose; wings fuscous; ratio of upper interocular distance to lower is 16:17; lateral ocelli 2.5 as far from eyes as each other; ratio of length of third and fourth antennal joints is 11:8, hence third antennal joint five-eights of vertex width; length 6.0 mm. Costa Rica . . . . . **33. fuscus,** new species
Head and abdomen not black 50

50. Body entirely bright blue, tinged with green on thorax; clypeus and face with strong silvery pubescence, and rest of head and thorax with rather strong sericeous pile; antennae entirely black; thorax with beautiful violet reflection in certain light; tegula black; propodeum rugose toward tip, especially on sides; wings hyaline, with bright slightly yellowish reflection, veins brown; legs blue with purplish reflection; size 8.5 mm. Cuba. **bellus** (Cresson)
Body not entirely bright blue 51

51. Wings noticeably fuscous; larger length about 8.0 mm; thorax bright green without purple reflection or if thorax not bright green the apical half of thorax with strong purple reflection 52
Wings clear hyaline, or if slightly fuscous abdomen black or if bluish wings with coppery iridescence; size smaller, length about 6.0 mm. 53

52. Thorax shining bright green, abdomen very dark with bluish reflection, shining; head not as bright colored as thorax; clypeus broadly rounded in front; upper and lower interocular distance equal (19); ratio of lengths of third and fourth antennal joints is 11:10; lateral ocelli 1.5 as far from eyes

as each other; coxae bluish green, legs faintly same color; antennae black; length 8.5 mm. Guatemala . . . . . **31. medius,** new species

Head and thorax a very dull green with faint purple reflection and abdomen bluish on basal half, the apical half with very strong violet reflection obscuring the bluish, shining; legs all black; coxae bluish and rest of legs only a faint blue; wings strongly fuscous, veins black; ratio of third and fourth antennae joints is 12:10; upper and lower interocular distance about equal (18); lateral ocelli 1.5 as far from eyes as each other; antennae black; pygidium not so smooth and shining as usual; anterior margin of clypeus broadly rounded; length 9.2 mm. Mexico . **32. hidalgoensis,** new species

53. Black, showing bluish reflections, especially on abdomen; thorax may be partly bluish; anterior margin of clypeus straight; wings fumose, rather darker over basal vein, in certain lights plainly coppery iridescent; second and third antennal joints equal to vertex width; propodeum faintly ridged on sides. Jamaica . . . . . **bruesi** (Banks)

Wings hyaline, abdomen and head not black 54

54. Thorax a medium bright green, with no trace of purple iridescence; clypeus and face black; abdomen dark blue in all light; apex of forewing no darker than rest of wing; third and fourth antennal joint equal in length (8); upright hair on top of vertex and front black; upper interocular distance slightly greater than lower; length 5.6 mm. Mexico.
51. minutus, new species

Thorax a dull bluish green with beautiful purple iridescence; clypeus and face with bluish iridescence; abdomen appearing black in certain light, but with deep-blue reflection; upright hair on vertex and front white; apex of forewing darker than rest of wing; third antennal joint slightly longer than fourth, ratio of their lengths is 11:9; upper interocular distance slightly less than the lower; length 6.0 mm. Mexico . . . **48. kathryni,** new species

MALES

1. At least basal abdominal segment wholly yellowish or yellowish with some black 2

Abdomen with no segments whitish or yellowish except the apical tergite may be white 6

2. Pronotum reddish and thorax with some reddish color; only the first one or two basal abdominal segments yellowish; face and clypeus yellowish; all of legs yellowish except tarsal joints and possibly some black on posterior coxae; last two antennal joints flattened 3

Pronotum black or with lower anterior corners and posterior border whitish; first three abdominal segments reddish a third with some black on dorsum or all segments reddish 4

3. Clypeus, face, and broad anterior orbits to above antennae shining glossy yellowish; first and about basal half of second abdominal segments yellowish; posterior coxae with some black; thorax almost black with some greenish color; first three and basal half of fourth antennal joints reddish. Trinidad. Figs. 24, 25 . . . . . **34. albifrons,** new species

Clypeus, sides of face, and anterior orbits to antennae a dull yellowish; middle of face blackish; the clypeus and face with much more and coarser pubescence than above; the first abdominal segment and only base of second yellowish; posterior coxae reddish; thorax black (some greenish) with streaks of reddish on sides of thorax and propodeum; antennae with less

color at base; base of posterior tarsi reddish. Trinidad, Barro Colorado Island. Figs. 12, 13 . . . . . **36. abnormalis,** new species

4. Whole abdomen reddish; pronotum reddish; front part of forewings from costal margin to back of cubital cells much darker than the rear half of forewings or the rear wings; sides of thorax reddish on sides just above coxae. Trinidad. Figs. 14,15 . . . . . **2. semialatus,** new species

Whole abdomen not rufous; pronotum not reddish; forewings unicolorus.

5. Basal three segments of abdomen reddish, the rest pubescent; narrowly edged with yellow at apex, the apical segment more or less testaceous; antennae covered with a microscopic pile, the apical joints brownish beneath; palpi, scape, antennae below, front of coxae and trochanters, yellowish; legs basally yellowish; wings hyaline; second cubital cell shorter than third above and below; first recurrent vein received before middle, the second on basal third; spur of posterior tibiae three-fourths as long as its metatarsal joint; length 5 mm. Mexico . . . . . **relativus** (Cameron)

Basal three segments of abdomen yellowish, but the third has a black stripe across posterior part; the other segments not edged with yellow; the pronotum not entirely yellowish; a white band across posterior edge of pronotum, the anterior front corners of pronotum with a white band which continues backward to posterior edge on lower side; the forecoxae white; all rest of legs yellow; the body color black without any greenish color; clypeus, face, and inner orbits to antennae whitisn; antennae black above, yellowish beneath; pubescence of body white; volsellae of genitalia with only a very few long hairs on apical third on inside; subgenital plate with the basal triangle closed much apicad of middle. Panama. Figs. 22, 23.

35. semirufus, new species

6. Clypeus with its apical edge much thickened and with a large rounded notch on each side of middle; head and thorax with a faint dark greenish iridescence, or black 7

Clypeus without its apical edge thickened (thin) and without a large rounded notch each side; if somewhat thickened without the notch 11

7. Lateral 0.35 and apical margin of clypeus whitish; apices of coxae and trochanters fulvous; basal triangle on subgenital plate closed at middle of subgenital plate. Mexico. Figs. 68, 69 . . . . . **mexicanus** (Cresson)

Clypeus all black or all white, or if lateral 0.35 white the apical margin of clypeus black and coxae all black, trochanters all fulvous 8

8. Clypeus with lateral 0.35 white but apical margin of clypeus black; apical center of clypeus projecting and with a large notch each side; coxae all black, trochanters all red. Honduras. Figs. 1, 2.

54. hondurensis, new species

Clypeus black or all white 9

9. Clypeus and face all white, anterior orbits white to antennae and narrowing to a pointed triangle about half way to anterior ocellus; last two pairs coxae and trochanters black, the anterior pair of both rufous; front pair femora yellowish; foretibiae and basitarsi yellowish, last two pairs tibiae and tarsi dark; front and vertex greenish, thorax a brighter green, abdomen black, antennae brown above yellowish beneath on first eight joints. Guatamala. Figs. 16, 17 . . . . . **52. bequaerti,** new species

Clypeus all black; coxae and trochanters black except trochanters may be yellowish; basal triangle on subgenital plate closed about apical fourth or if at about the middle the plate is more nearly flat not so strongly roof-shaped; front and vertex black but with a trace of greenish color; inner orbits slightly whitish.

10. Sides of thorax black, only the dorsum of thorax with a dull greenish color; upper interocular distance equal to the lower (12); parameres of genitalia rather small acute at apex; the cross-ridge about middle of paramere located just opposite the apex of volsellae; smaller, length 8.0 mm. Honduras. Figs. 10, 11 . . . . . **40. clypeatus,** new species

Sides of thorax with some green color mostly in the grooves; upper interocular distance greater than the lower in ratio of 22:20; parameres of genitalia very large (largest of the genus when compared to rest of genitalia), obtuse at apex; the cross-ridge about the middle of parameres located well above apex of volsellae; larger, length 11.9 mm. Yucatan. Figs. 30, 31. **47. gaumeri,** new species

11. Face with a dense golden pubescence; body black; clypeus transverse, widely emarginate in front; head with long thin black pubescence; thorax thinly covered with black pubescence; tips of anterior femora in front, tibiae in front and their apex reddish; wings flavohyaline, their apical margins faintly clouded; a fuscous fascia in forewings at base of marginal cell; abdomen subpetiolate, black with an obscure blue tinge, apex with short black pubescence; length 8 mm. Mexico . . . . **montezumus** (Smith)

Face without dense golden pile 12

12. All legs black 13

At least some of legs yellow or rufous 15

13. Head and thorax black, sometimes showing bluish reflections especially on abdomen; parameres of genitalia with apical half very broad and heavy; the subgenital plate without a raised flat triangular area at base, the very sharp elevated ridges start at base. Jamaica. Figs. 4, 5 . . **bruesi** (Banks)

Head and thorax not both black, abdomen black 14

14. Head and thorax both bright shining blue; parameres and subgenital plate similar to bruesi; antennae black. Cuba. Figs. 36, 37 . **bellus** (Cresson)

Head black; thorax with basal 0.75 of propodeum greenish, apical 0.25 black with rather dense, prostrate, white pubescence; some parts of dorsum of thorax and sides with streaks of greenish; length 10.5 mm. Mexico. Figs. 28, 29 . . . . . **46. vulcanensis,** new species

15. Clypeus and face all white, or white on sides and a brown longitudinal streak in middle covering one-third or less of width, or with only outer edges white 16

Clypeus generally without any white, all black; face black or black with their anterior orbits white 21

16. Head and thorax a dull-green color with purple reflection; abdomen black with a white spot on seventh tergite, and third tergite may be reddish . 17

Head thorax and abdomen black with hardly any noticeable reflection . 19

17. Clypeus and face with only the outer edges white; apex of clypeus without a transparent rim; the white on face does not reach antennae, on the sides the space below antennae black; antennae black except the first joint below is yellowish; all coxae and trochanters are black, abdomen black, except third tergite is reddish and seventh tergite has a white spot in middle; parameres of genitalia without a cross-ridge about middle opposite apex of volsellae; the parameres narrower and more acute at apex; basal triangle of subgenital plate closed at middle; length 6.6 mm. Mexico. Figs. 38, 39 . . . . . **45. amoenus,** new species

Clypeus with the outer two-thirds white, the middle third with a brown stripe, or the brown stripe almost evanescent, only visible in certain reflected light; the face white on sides, the white color reaching antennae on the sides; in one case and almost so in the other case; at least the forecoxae

and all the trochanters yellow; antennae yellow below, brown or black above; mouth parts bright yellow, thorax with at least some parts strongly bluish or greenish; abdomen with a violaceous color not black; dorsal surface of last tergite white; space below antennae white or bluish . . 18

18. Face and clypeus appearing all white in certain light, in other light middle third is brown, the white reaching antennae below and on sides; front just above antennae with a blue-greenish stripe which covers lower half of front; upper half of front, vertex posterior orbits, dorsal surface or thorax, and most of sides of thorax, black; the sides of thorax just above middle coxae bluish green; abdomen brownish, slightly violaceous; first two pairs of coxae yellowish; posterior tibiae black on dorsal surface; genitalia and subgenital plate larger than in *marginalis;* the basal triangle on subgenital plate closed about apical third; length 7.6 mm. Panama. Figs. 8, 9 . . . . . **42. argentinus,** new species

Face and clypeus with a dark brown stripe in middle third in any reflection, the white of face not reaching antennae either on sides or below; the face bluish green just below antennae; the rest of head and all thorax green or bluish green, with very strong purple reflection; abdomen similar in color to *argentinus;* only the forecoxae yellowish; posterior tibiae purplish on dorsal surface; basal triangle on subgenital plate closed at basal third; length 7.3 mm; while length is the same as *argentinus* the subgenital plate is hardly half as large. Mexico. Figs. 26, 27.

43. marginalis, new species

19. Head, thorax, and abdomen black with no trace of color; face and clypeus whitish with a dark streak in middle; only the first pair coxae yellowish, last two pairs black; all femora yellowish but last pair black at base and/or at tip; veins of wings dark yellowish or black 20

Head and thorax barely showing bluish in reflected light; propodeum and dorsum of thorax showing beautiful purple sheen in certain light; only a trace of a brown streak in middle of clypeus, but darker on face; first two pairs coxae and trochanters yellow, last pair black; all femora and first two pairs tibiae yellow; foretarsi almost all yellow, posterior tibiae and last two pairs tarsi dark; veins of wing and stigma yellow. Mexico, Honduras. Figs. 20, 21 . . . . . **38. woodi,** new species

20. All the femora yellowish but last pair black at base and apex; wing veins light yellowish; last two pairs tibiae black; last four joints of foretibiae and all last two pairs black; subgenital plate with raised basal triangle open almost to apex of plate; parameres of genitalia broader and slightly shorter; volsellae broader and longer. Panama. Figs. 6, 7.

53. gertschi, new species

All femora yellowish but last pair black at base only; wing veins dark yellowish; all tibiae yellowish; only last two joints of foretarsi dark, the first tarsal joints of last two pairs dark reddish, remaining joints black; parameres of genitalia more slender and slightly longer than above. Mexico. Figs. 40, 41 . . . . . **44. atratus,** new species

21. All coxae and trochanters reddish; first antennal joint yellow above and below; last three antennal joints abnormal, flattened and widened; all the legs yellowish except tarsal joints of last two pairs of legs; sides and ventral surface of pronotum or most of it yellowish; dorsal surface of pronotum and mesonotum bluish green, propodeum black except in certain light a trace of color; thorax with some reddish color on sides and on dorsal surface of propodeum; abdomen black. Panama. Figs. 12, 13.

36. abnormalis, new species

Some or all of coxae black or at least very dark-colored; first antennal joint not yellow above and below; last three joints of antennae not flattened and widened 22

22. Coxae not deep black, strongly dark reddish; first two pairs tronchanters same color, last pair yellow; head, dorsum of thorax, and sides of posterior half of thorax greenish, anterior half black, clypeus reddish in center (more like faded black); a rather broad yellowish stripe on inner orbits to just above antennae; labial palpi yellow; abdomen black with a yellowish streak on sides of first tergite. Trinidad. Figs 18, 19.
41. aeruginosus, new species

All coxae deep black; head thorax and abdomen deep black, except for small marks 23

23. A white line on inner orbits to just above antennae; all trochanter, femora, and tibiae rufous; basal joint of foretarsi yellow, last four joints, and all joints of last two pairs dark, antennae black above, brown beneath. Costa Rica. Figs. 34, 35 . . . . . **37. niger,** new species

Anterior orbits black; foretrochanters yellowish, last two pairs black; all femora rufous, but second pair dark at base, third pair black on almost basal third; first two pairs tibiae yellowish beneath, dark above, posterior pair dark above and below except reddish below on apical third; body long and shaggy-haired; antennae black above, brown below. Panama. Figs. 32, 33 . . . . . **39. anthracinus,** new species

1. *Auplopus shannoni*, new species

Holotype female. Head black (very slight greenish reflection), thorax green (slightly bluish, and very slight purplish reflection in certain light), abdomen wholly red, except pedicel black; head, thorax, and coxae with light glistening, almost half as long as basal antennal joint on propodeum; antennae yellowish underneath, black dorsally and apical one or two joints underneath; clypeus produced in front, typical; clypeus twice as wide as long (20); upper and lower interocular distance equal (19); lateral ocelli 1.5 as far from eyes as each other, foreocellus the largest; ratio of length third and fourth antennal joints is 16:13; head 0.8 as long as broad; vertex even with eyes (ocelli slightly raised), no posterior orbits and temples evanescent; labial palpi very long (longer than width of clypeus); mouth parts fuscous; posterior edge of pronotum transverse, the dorsal surface hidden by dense, prostrate, brownish pubescence; propodeum with apical half covered with dense, silvery, prostrate pubescence; the apical half of propodeum and sides lightly striate; wings hyaline with bright reflection with greenish hues; basal and transverse veins only slightly disjointed; first recurrent meets second cubital cell about middle, second at basal fourth; coxae and trochanters dark with bluish luster; all femora and first pair tibiae dark yellow (reddish), the middle and

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posterior tibiae dark purple, in certain light, on dorsal surface, middle pair reddish underneath; all tarsi dark.

Length head and thorax 5.3 mm., abdomen 4.3 mm., forewing 9.2 mm., rear wing 6.6 mm.

Holotype female: Cano Saddle, Gatún, Panama, May 3, 1923, R. C. Shannon (USNM).

2. *Auplopus semialatus*, new species

FIGURES 14, 15

Holotype female. Head and thorax mostly black, abdomen red; mouth parts, all mandibles, clypeus, face, broad anterior orbits to about middle of front, lower third of posterior orbits under head, and all of basal antennal joints, light yellow; all of under side of antennae yellowish, the dorsal surface reddish brown; pronotum wholly reddish, except front corners at sides are more yellowish; the sides of thorax just above middle and posterior coxae, reddish (obscured in certain light by golden pubescence); abdomen light red except dorsal base of first tergite (pedicel); legs from coxae on same color as abdomen, except last joints of posterior tarsi are dark; the black part of body with dense, prostrate golden pubescence, especially dense just above last two pairs coxae and a streak across base of propodeum and across apical half of propodeum; clypeus as usual, 1.4 as wide as long, a narrow shining hairless rim on front; labial palpi exceptionally long, almost twice as long as width of clypeus; ratio of length of third and fourth antennal joints is 18:15; upper interocular distance equals 0.9 lower interocular (which is equal to third antennal joint); head as broad as long; foreocellus the largest, the laterals 1.6 as far from eyes as each other; forewing very dark brown from costa back to median vein and just back of cubital cells, the rear of forewing and all of rear wing yellowish hyaline, very noticeable; basal veins disjointed about twice width of vein; the bright golden pubescence and colors make this a beautiful species.

Length of head and thorax 5.3 mm., abdomen 5.3 mm., forewing 10.6 mm., rear wings 8.0 mm.

Holotype female: Rio Trinidad, Panama, Mar. 23, 1912, A. Busck (USNM).

Paratypes: 1, same data as holotype (USNM); 1, Barro Colorado Island, June 14, 1939, Zetek 4453, lot 89–12571 (USNM); 1, Mojinga Swamp, Fort Sherman, C.Z., Aug. 15, 1951, trap, F. S. Blanton (USNM); 1, Barro Colorado Island, C.Z., Feb. 9, 1936, F. E. Lutz (AMNH).

Allotype male. Colored as in the female, except that all the joints of last tarsi are dark, and there is more yellow on sides of thorax; ratio of length of third and fourth antennal joints is 9:9, antennae is very slender; clypeus 1.75 as broad as long; does not extend under eyes; lower interocular distance equal to the upper (14); transfacial distance 1.75 times the interocular; head 1.15 as broad as long; lateral ocelli 1.5 as far from eyes as each other; genitalia with the parameres rather slender, almost acute at apex; the transverse ridge near middle of parameres deeply concave on apical side (usually almost straight) and located below the apex of volsellae; the flap at base of volsellae short rather abruptly, somewhat pointed; subgenital plate with the basal triangle closed about the middle; genitalia very small for size of insect.

Length head and thorax 3.6 mm., abdomen 3.9 mm., forewing 6.8 mm., rear wing 5.2 mm.; length genitalia 0.93 mm., width 0.53 mm., length subgenital plate 0.93 mm., width 0.40 mm.

Allotype male: Mojinga Swamp, Fort Sherman, C.Z., Aug. 15, 1951 (trap), F. S. Blanton (USNM).

3. *Auplopus splendens*, new species

Holotype female. Head and thorax deep, shining, green; abdomen dark brown, shining; clypeus, face, inner orbits to just above antennae, and most of thorax with dense, prostrate, golden, shining, pubescence; first three joints of antennae bright yellow, beyond third joint antennae dull yellowish below, becoming darker toward apex, the upper surface beyond middle of fourth joint dark; the apex of clypeus, apical half of mandibles and mouth parts, yellowish; legs yellow from trochanters to apex of basal tarsal joints; the last two tarsal joints of forelegs, last three of middle legs, and last four joints of posterior pair, dark; coxae yellowish on most of apical half below, rest bluish green; clypeus of usual shape 2.25 as wide as long; ratio of length of third and fourth antennal joints is 14:10; upper interocular distance (16) equal to the lower; head 1.25 as broad as long; anterior ocellus the largest, the laterals 2.0 as far from eyes as each other; pronotum very short dorsally, transverse behind, and with a line of dense pubescence preapically; a groove on middle of propodeum; wings yellowish, veins and stigma yellowish; abdomen brown with lighter color on apical edge of tergites, pruinose.

Length head and thorax 4.6 mm., abdomen 4.0 mm., forewing 8.5 mm., rear wing 6.5 mm.

Holotype female: Chiriqui Bamito, Volcán, Panama, December 1946, N. L. H. Krauss (USNM).

4. *Auplopus femur-rubrus*, new species

Holotype female. Head and thorax opaque black, abdomen black, shining through pruinose vestiture; mandibles slightly reddish at apex, labial palpi dull reddish; legs all black except the femora which are all a light red, except extreme base and the knees, which are dark; head and thorax with a somewhat silky white pubescence, some of hairs prostrate others upright; antennae black with a yellow streak on underside of joints five to the tip; clypeus broadly rounded in front; mouth parts dark brown, mandibles reddish, apically; clypeus 1.6 as wide as long, the front edge with a slightly upturned rim, and strongly convex in middle; upper and lower interocular distance equal (18); ratio of lengths of third and fourth antennal joints is 19:12; head as broad as long; foreocellus the largest, laterals 2.3 as far from each other as from eyes; wings slightly fuscous, darker at tip, veins and stigma dark; basal and transverse veins in forewings the width of a vein apart, the veins in rear wings interstitial.

Length head and thorax 5.1 mm., abdomen 4.7 mm., forewing 7.2 mm., rear wing 6.6 mm.

Holotype female: Barro Colorado Island, C.Z., May 19, 1939, Zetek 4434, lot no. 89–12208 (USNM).

Paratypes: 1, same data as holotype (USNM); 4, same data as holotype except date June 14, 1939, 4453, lot no. 39–12571.

5. *Auplopus villosus*, new species

Holotype female. Head and thorax black with dull-greenish color in reflection, abdomen black, apices of tergites slightly reddish; head and thorax more or less covered with rather coarse, prostrate, yellowish pubescence, and with considerably upright yellowish, shaggy hair; forefemora with considerable long hair beneath, the other two pairs with lesser amount; abdomen rather closely covered with somewhat dense, rather coarse, yellowish pubescence, even some on the shining pygidium; antennae yellow, very slender, even joint three hardly thicker than the rest of joints except three or four apical ones; clypeus as usual, about 1.6 as broad as long; upper interocular distance (18) slightly less than the lower (19); head very slightly longer than broad; ratio of lengths of third and fourth antennal joints is 19:14; very narrow posterior orbits, hardly any temples; posterior edge of pronotum transverse, densely haired on dorsal surface with prostrate hair; wings yellowish, with yellow veins and stigma; basal veins offset by twice the thickness of vein, in rear wings veins offset by three times thickness of vein; propodeum densely haired at outer posterior corners with prostrate hair; coxae yellowish on ventral surface,

blackish above; trochanters and all rest of legs dark yellowish, except apical tarsal joint blackish.

Length head and thorax 4.6 mm., abdomen 4.6 mm., forewings 9.9 mm., rear wings 7.3 mm.

Holotype female: San Jose, Costa Rica, M. Valerio, no. 85 (USNM).

6. *Auplopus nebulosus*, new species

Holotype female. Head opaque black, thorax dull greenish with purple reflection, abdomen black with slight bluish reflection; a little upright hair on clypeus, front, vertex and pronotum, much more and longer on propodeum; considerable appressed, somewhat silvery, inconspicuous pubescence on head and thorax; antennae black; apex of clypeus, apex of mandibles and mouth parts, brown; coxae dark, with bluish reflection; trochanters, femora, tibiae, and basal tarsal joints, light reddish; last four tarsal joints dark; clypeus as usual, twice as wide as long; head and thorax not punctured; upper interocular distance (18) 0.9 as long as lower; head 0.9 as long as broad; ratio of length of antennal joints is 15:12; foreocellus the largest, laterals 1.5 as far from eyes as each other; posterior orbits evident, temples evanescent; wings hyaline, contrasting with black veins and stigma; basal veins displaced about twice thickness of vein, in rear wings subdiscoidal and cubitus displaced about three times thickness of vein; legs not smooth but with pubescence.

Length head and thorax 5.3 mm., abdomen 5.0 mm., forewing 8.8 mm., rear wing 6.6 mm.

Holotype female: San Jose, Costa Rica, May 1940, Sternitzky (USNM).

7. *Auplopus opacus*, new species

Holotype female. Head and thorax green with some bluish and purplish reflection, abdomen reflecting blue and purple, clypeus and face densely white pubescent (completely hiding integument), the front, vertex, and thorax not so densely pubescent, except outer posterior corners of propodeum; fairly well-haired with upright hair as well; abdomen densely, finely pubescent all over except pygidium; the colors shining through in reflected light; basal joint and next two or three joints yellowish underneath, the rest darker, black dorsally; coxae black; trochanters, femora and tibiae reddish yellow; basal two tarsal joints of foretibiae yellowish, rest of tibiae much darker (last two pairs tibiae darker on knees); mentum, mouth parts, and apex of mandibles bright yellow, apex of normal clypeus slightly reddish; clypeus 2.0 as wide as long; upper interocular distance (16) only about 0.85 that of lower; head 1.2 as broad as long; ratio

length third and fourth antennal joints is 14:11; foreocellus is the largest, the laterals 1.5 as far from eyes as each other; head and mesonotum hardly punctate, more aciculate; tegula yellowish; wings hyaline, veins and stigma, black; first recurrent vein meets second cubital cell before middle, the second recurrent meets its cell at basal fourth.

Length head and thorax 5.0 mm., abdomen 5.0 mm., forewings 7.6 mm., rear wing 6.3 mm.; the veins on under side of wing are slightly yellowish.

Holotype female: Trap catch, Arraizan, Panama, January–October 1947, Zetek 5316 (USNM).

8. *Auplopus minus*, new species

Holotype female. Head and thorax green, abdomen black and shining, no noticeable reflection; face, clypeus, and sides of thorax with rather dense, yellowish, prostrate pubescence, front, vertex, and dorsal surface of thorax not so dense; first three antennal joints, yellow above and below, from there to apex yellowish below, black above; apex mandibles and mouth parts bright yellow; coxae greenish; trochanters, femora, tibiae, and basal joint of tarsi bright yellow; the apex of tarsi dark; clypeus normal, 2.0 as broad as long; upper interocular distance (15) equal to the lower; head 1.15 as broad as long; ratio of third and fourth antennal joints is 13:11; tegula, wings, veins, and stigma, yellowish; wings shining, yellowish in reflection, hyaline; basal veins disjointed about 0.5 the length of basal, in rear wings veins disjointed about the same distance; temples and posterior orbits evanescent.

Length head and thorax 4.0 mm., abdomen 4.0 mm., forewings 7.0 mm., rear wings 5.3 mm.

Holotype female: Barro Colorado Island, C. Z., June 14, 1939, Zetek 4453, lot no. 39–12571 (USNM).

9. *Auplopus zeteki*, new species

Holotype female. Head and thorax green, abdomen black with slight, bluish reflection, shining and pruinose; first two joints of antennae black underneath and on whole dorsal surface, yellowish underneath from base of third joint; last two pairs femora reddish (except at extreme base) as well as foretibiae; anterior femora with basal half black; all tibiae black, except basal three joints of foretibiae are yellowish; coxae bluish green, trochanters black; labial palpi yellowish, rest of mouth parts and mandibles dark; face and clypeus densely, silvery sericeous, the thorax more lightly sericeous; clypeus

as usual, 2.0 as broad as wide; upper interocular distance (18) slightly less than lower; head 1.25 as broad as long; ratio of length of third antennal joint to fourth is 16:11; for ocellus slightly largest, laterals 2.0 as far from eyes as each other; wings hyaline, veins and stigma black.

Length head and thorax 4.6 mm., abdomen 6.0 mm., forewings 7.3 mm., rear wings 5.2 mm.

Holotype female: Barro Colorado Island, C.Z., June 14, 1939, Zetek 4453, lot no. 39–12571 (USNM).

Paratype: 1, Mexico 2387, C. F. Baker (USNM).

10. *Auplopus panamensis*, new species

Holotype female. Head and thorax bright shining green, abdomen shining black, somewhat pruinose; mouth parts and apex of mandibles yellowish; antennae bright yellow underneath, dark reddish on dorsal surface; coxae and trochanters greenish to purplish; all femora and tibiae bright yellow; foretibiae same color except three apical joints, basal joint of last two pairs reddish beneath, dark on dorsal surface, rest all dark; a very narrow, obscure yellowish mark on anterior orbits from base of antennal sockets about half way to foreocellus; clypeus and face, densely, silvery, silky, sericeous; a patch across apex of propodeum of silvery pubescence, not quite so strong as on face; thorax with scattered patches of silvery pubescence; clypeus as usual, 2.0 as broad as long; upper interocular distance (14) is equal to the lower; ratio of length of third and fourth antennal joints is 12:10; head 1.1 as broad as wide; foreocellus slightly larger than laterals, the latter 1.5 as far from eyes as each other; wings hyaline, veins and stigma light yellowish; basal veins in forewings, subdiscoidal and cubital in rear wings disjointed about same amount, about one half length of transverse; first recurrent meets second cubital cell about middle, second meets third cubital cell beyond basal fourth.

Length head and thorax 4.0 mm., abdomen 2.7 mm., forewing 7.0 mm., rear wing 5.3 mm.

Holotype female: Rio Trinidad, Panama, Mar. 16, 1912, A. Busck (USNM).

11. *Auplopus sapphirus*, new species

Holotype female. Clypeus, face and front black, vertex greenish, thorax green with blue and purple reflection, abdomen black, shining, with very faint bluish reflection; mouth parts brown; trochanters blackish with some yellow, coxae black with faint bluish reflection; all femora and tibiae reddish, as well as basitarsi of forelegs; rest of

tibiae dark; clypeus as usual, twice as broad as long; head 1.2 as broad as long; upper interocular distance (18) equal to the lower; length third joint antennae 13 (rest of antennae lost) compared to 18 vertex width, the second and third joint (16) not quite equal to vertex width; wings hyaline, with brilliant slightly yellowish reflection, the veins and stigma black; the basal veins in forewings disjointed about the width of a vein, in rear wings subdiscoidal basad of cubitus by about twice thickness of a vein; propodeum with only a very slight slope, broad almost flat; clypeus and face silvery sericeous, slightly sericeous, slightly sericeous on parts of thorax, sides of propodeum and outer posterior corners strongly sericeous; posterior half of propodeum with long, upright whitish hair, head and thorax with generally shorter and less hair.

Length head and thorax 4.6 mm., abdomen 4.0 mm., forewing 7.5 mm., rear wing 5.6 mm.

Holotype female: Palmar, Prov. Puntareanas, Costa Rica. P. & D. Allen (USNM).

12. *Auplopus exilis*, new species

Holotype female. Clypeus black, head and thorax green with some purplish reflection, abdomen brown with the faintest trace of bluish in certain light, shining, almost covered with very fine prostrate pubescence, pruinose; very tip of clypeus, and apex of mandibles faint yellowish; mouth parts bright yellowish, with the basal joints of palpi brownish; hair beard on mentum with hairs rather thick and almost black, very prominent in comparison with the other yellow parts; coxae black with purple reflection, trochanters dark, yellowish below; all femora and first two pairs of tibiae bright yellow; basal two joints of forelegs yellow, last three joints and tarsi of last two pairs of legs dark; tibiae of posterior legs dark in certain light with slight purple reflection, in other light dull reddish, but much darker than other tibiae and femora; antennae yellowish underneath except last joint which is black, brown above but last joint darker, very slender; clypeus as usual, twice as broad as long, clypeus, face and sides of propodeum with densely, silvery, prostrate pubescence, the sides and ventral surface of thorax about the same; ratio of length of third and fourth antennal joint is 11:9; head 1.25 as broad as long; upper interocular distance (13) equal to the lower; wings hyaline, brilliant reflection in reflected light; longer spur of posterior tibiae 0.7 as long as its metatarsal joint.

Length head and thorax 4.0 mm., abdomen 4.3 mm., forewing 6.3 mm., rear wing 4.6 mm.

Holotype female: La Campana, Panama, January–March 1938, fruit fly trap, Jas. Zetek no. 4104 (UNSM).

13. *Auplopus carinus*, new species

Holotype female. Head and thorax green and bluish green with purple reflection, abdomen blackish with blue and green reflection, shining; coxae and trochanters dark with greenish color and purple reflection; forefemora dark on basal third, last two pairs dark on about basal fifth, the rest of femora, reddish yellow, last pair with dark knees; foretibiae only, yellowish, last two pairs and all tarsi dark; spur of foretibiae yellow, last two pairs color of tarsi; last pair tibiae tend to a dark reddish color in certain light with the dorsal surface with purple reflection; clypeus, face, sides of thorax, and sides of propodeum with dense, prostrate, silvery pubescence; body rather hairy especially the propodeum which has long white hair; mouth parts yellowish; shape of clypeus as usual, a raised rim on apex, surface punctured, 1.67 as broad as long; upper interocular distance (19) equal to the lower; head 0.9 as long as broad; ratio of length of third and fourth antennal joints is 16:13; first antennal joint whitish below, remaining joints yellow below, all black above; foreocellus the largest, the laterals 1.25 as far from eyes as each other; a faint yellowish line on inner orbits opposite base of antennae; wings slightly brownish, veins and stigma dark; mesonotum finely punctured, front aciculate; abdomen with posterior edge of tergites 2 to 5 slightly reddish and with a different sheen than rest of segment; longer spur of posterior tibiae 0.5 as long as its metatarsal joint.

Length head and thorax 6.6 mm., abdomen 4.3 mm., forewing 8.6 mm., rear wing 6.6 mm.

Holotype female: Rio Trinidad, Panama, Sept. 3, 1912, A. Busck P-5 (USNM).

14. *Auplopus grossus*, new species

Holotype female. Clypeus and face black (completely covered by dull whitish pubescence), front and vertex a dull green, with purple reflection; thorax a dull green with deep purple reflection on dorsal surface, the sides and propodeum with bright shining green, with less purple reflection; abdomen dark with some light greenish reflection in certain light, but this color almost obscured by the brilliant shining violet-purple reflection; the sides of thorax and propodeum covered by the dull white, rather coarse, pubescence of the clypeus and face; antennae wholly black, the apex of joints larger than the base giving a knobby appearance at the juncture of the joints; coxae black, strongly greenish, trochanters black; all femora reddish yellow,

the extreme base dark and also the knees of last pair; foretibiae yellow, rest dark; basal joint of foretarsi slightly yellowish, the other joints and last two pairs of tarsi dark; visible part of mentum reddish, apex of mandibles reddish; the basal two joints of labial palpi very much thicker (3 to 4 times) than the three apical joints, basal brown, apical yellowish; clypeus as usual, 1.9 as broad as long; head almost as long as broad; ratio of length of third and fourth antennal joints is 19:14; upper interocular distance (22) only 0.85 that of lower, eyes slightly converging above; foreocellus the largest, laterals 1.5 as far from eyes as each other; head and mesonotum very finely and densely punctured; wings yellowish, veins and stigma black, glistening in reflected light, with purple iridescence in cubital cells (generally this color is green); the first tergite with medium length, upright white hair; the whole abdomen covered with very fine, prostrate pubescence; longer spur posterior tibiae only 0.33 the length of metatarsal joint.

Length head and thorax 7.0 mm., abdomen 6.0 mm., forewings 11.6 mm., rear wings 8.4 mm.

Holotype female: Barro Colorado Island, C.Z., January–March 1944, Zetek 5125 (USNM).

Paratypes: 6, same data as holotype (5, USNM) (1, RRD); 5, Barro Colorado Island, C.Z., April and May 1942, Zetek 1942 and 1953 (USNM).

15. *Auplopus guatemalensis*, new species

Holotype female. Clypeus, face and antennae black, front, vertex, mesonotum and pronotum faint dull green, sides of thorax and propodeum a brighter stronger green, slightly bluish; abdomen black with faint bluish reflection; apex of mandibles reddish, mouth parts dark (apical joints of labial palpi brownish); coxae and trochanters black; all femora, foretibiae and middle tibiae reddish; posterior tibiae and all tarsal joints dark; clypeus, face, and thorax with rather inconspicuous prostrate silvery pubescence, upright, white hairs on propodeum, few elsewhere; clypeus normal, 2.0 as broad as long; a hairless, polished rim around apex, widest in middle; eyes converging above, the upper interocular distance (17) 0.85 that of lower; head 1.2 as broad as long; ratio of length of third and fourth antennal joints is 14:11; anterior ocellus the largest, laterals 1.25 as far from eyes as each other; wings hyaline, veins and stigma black; longer spur posterior tibiae half as long as its metatarsal joint.

Length head and thorax 4.6 mm., abdomen 4.6 mm., forewing 8.0 mm., rear wing 5.6 mm.

Holotype female: Yepocapa, Guatemala, April 1948, H. T. Dalmat (USNM).

16. *Auplopus aquilus*, new species

FIGURE 75

Holotype female. Clypeus and rest of head dull greenish color with faint purple reflection; dorsal surface of thorax, including propodeum, almost black, only very faint greenish color in places, but with a faint purplish cast all over, the sides plainly blue greenish with the same faint purple reflection; abdomen black with beautiful purple and violet iridescence shining through the fine, dense, pruinose pubescence; antennae yellowish underneath, brown above; coxae and trochanters with strong violet iridescence; all femora and first two pairs of tibiae yellow, posterior tibiae dark with faint purple reflection; basal joint foretibiae yellow, the other joints and the other tarsi dark; apex of clypeus and apex of mandibles reddish, mouth parts dull yellowish; clypeus normal, twice as broad as long, with a rather broad, hairless, shining rim (reddish); head 1.2 as broad as long; ratio of length of third and fourth antennal joints is 14:12; upper interocular distance (15) not quite 0.9 the lower; foreocellus the largest, the laterals 1.5 as far from eyes as from each other; posterior orbits and temples evanescent; wings hyaline, veins, stigma, and tegula yellowish; propodeum with a central longitudinal furrow, the surface each side with fine transverse ridges; longer spur of posterior tibiae two thirds as long as its metatarsal joint; first recurrent vein meets first cubital cell in center, the second meets third cubital cell at basal fourth; the basal veins in forewings disjointed a distance of about one half length of transverse vein, in rear wings the subdiscoidal basad of cubitus about the same length; wings hyaline, glistening in reflected light with spots of green reflection.

Length head and thorax 4.6 mm., abdomen 5.0 mm., forewings 7.5 mm., rear wings 5.3 mm.

Holotype female: Cuba, at light in hold, Aug. 5, 1935, Baltimore 3541 (USNM).

Paratypes: 1, on banana debris from Nicaragua, New Orleans, 13116 (USNM); 1, Mexico, on banana trash, Dec. 11, 1935, New Orleans, 14832 (USNM); 1, on banana debris from Mexico, Oct. 11, 1934, New Orleans, 10195, M. S. *Mirinian* (USNM).

17. *Auplopus incognitus* (Smith)

Female. Head, thorax and abdomen completely black, except for a very narrow yellow line on inner orbits just opposite base of antennae; anterior coxae black, last two pairs bright shining, reddish;

femora and tibiae all same color; foretarsi and middle tarsi except last two joints, basitarsi of posterior tarsi, red, last four joints lost; antennae black, except last two joints yellowish; apex of mandibles reddish, the labial palpi yellow, other mouth parts darker; clypeus of usual shape, 1.8 as broad as long; upper interocular distance (17) about equal to the lower; head slightly broader (32) than long (30); ratio of length of third and fourth antennal joints is 11:10; clypeus and face with prostrate, silvery pubescence as well as upright hair, giving a rather rough appearance; wings deep brownish yellow, tegula, veins, and stigma yellow; propodeum with a patch of silvery pubescence on the posterior outside corners; longer spur of posterior tibiae two thirds as long as its metatarsal joint; abdomen shining pruinose.

Length of head and thorax 4.3 mm., abdomen 4.0 mm., forewing 6.7 mm., rear wing 4.6 mm.

Specimens from Costa Rica, July 24, 1955, no. 631–357, M.S.V. (locality illegible) (USNM); Acayucan, Vera Cruz, Mexico, Oct. 23, 1957, R. and K. Dreisbach (RRD); Xilitla, San Luis Potosi, Mexico, July 23, 1954, R. R. Dreisbach (RRD).

18. *Auplopus olivarus*, new species

Holotype female. Clypeus black, head and mesonotum dull green, propodeum and sides of thorax, brighter shining green; abdomen black, with no noticeable colored reflection, shining and with prostrate pruinose pubescence; antennae brown underneath, black on top; apex mandibles reddish, mouth parts dark brown; coxae and trochanters black; all femora and the first two pairs of tibiae reddish; forebasitarsi reddish, but darker than tibiae, and the rest of tarsal joints black; head and thorax pretty well covered with a somewhat coarse, prostrate, brownish pubescence; clypeus as usual, a trifle over 2.0 as broad as long; ratio of length of third antennal joint to fourth is 11:9; upper interocular distance (14) equal to the lower; head 1.2 as broad as long; foreocellus the largest, the laterals 1.5 as far from eyes as each other; wings, clear, hyaline, the first recurrent vein meets the second cubital cell at middle, the second recurrent meets third cubital cell at basal 0.2 (much closer to base than any other species); abdomen shining with a faint bluish tinge; longer spur of posterior tibiae about 0.4 as long as its metatarsal joint.

Length of head and thorax 4.0 mm., abdomen 4.6 mm., forewing 7.3 mm., rear wing 4.6 mm.

Holotype female: Barro Colorado Island, C.Z., June 14, 1939, Zetek 4453, lot no. 39–1257 (USNM).

19. *Auplopus purpureus*, new species

Holotype female. Clypeus, head, and thorax rather a bright green, with purple reflection; abdomen black in certain light, but mostly a brilliant violet, purple, and some bluish reflection, except pygidium which is dark yellowish, same color as legs; antennae rather bright yellow beneath, dark brown to black above; mandibles black on basal half, yellow apically, mouth parts dark yellowish; coxae and trochanters black with green reflection; all femora and first two pairs of tibiae dark yellow; posterior tibiae and all tarsi black, the posterior dark reddish in certain light with purple reflection; clypeus and face strongly sericeous pubescent, the thorax pubescent all over (not nearly as strongly as clypeus and face), and the propodeum across apical third almost as strongly as face and clypeus; clypeus usual shape, with a shining rather wide yellowish apical rim, 2.0 as broad as long; head 1.2 as broad as long; ratio of third and fourth antennal joints is 13:11; upper interocular distance (16) equal to the lower; foreocellus the largest, the laterals almost 1.5 as far from eyes as each other; wings hyaline, tegula, veins, and stigma dark; the two recurrent veins meet second and third cubital cells respectively at the middle and at basal third; longer spur posterior tibiae not quite half as long as its metatarsal joint.

Length head and thorax 4.6 mm., abdomen 4.6 mm., forewing 7.2 mm., rear wing 5.3 mm.

Holotype female: Barro Colorado Island, C.Z., January–March 1944, Zetek 5125 (USNM).

20. *Auplopus violaceus*, new species

Holotype female. Clypeus brown, greenish each side; rest of head and thorax dull greenish on dorsal surface, brighter greenish on sides and on propodeum; the thorax and propodeum with beautiful purple reflection; abdomen with blue, violet, and purple reflection, almost black without the strong brilliant reflection; a yellowish stripe on anterior orbits from base of clypeus to halfway between base of antennae and the anterior ocellus; antennae reddish brown beneath, almost black above, the four apical joints flattened; coxae yellowish beneath, light colored on sides and beneath, the sides and dorsal surface strongly reflecting violet; trochanters blackish, the forefemora dark-colored except the yellow apex; the last two pairs of femora dark yellowish, with base and apex blackened; foretibiae bright yellow like apex of femora, the last two pairs much darker colored, a dark reddish; the foretarsi dark yellowish, the last two pairs just about the color of tibiae (dark reddish) but slightly darker; apex of

mandibles and mouth parts yellowish; clypeus extended at the middle of apex into a distinct broad tooth, the sides of apex each side concave, the concavity (slight) reaching to the side opposite the interior orbits; clypeus 1.5 as broad as long; ratio of length of third and fourth antennal joint is 17:14; upper interocular distance slightly less than (0.9) that of the lower; head 1.3 as broad as long; lateral ocelli 1.6 as far from eyes as each other; face, clypeus, and most of thorax silvery pubescent; abdomen with very fine pubescence, pruinose; wings clear, yellowish, the veins and stigma bright yellow; the longer spur of posterior tibiae slightly more than 0.5 as long as its metatarsal joint.

Length head and thorax 4.9 mm., abdomen 4.9 mm., forewing 7.3 mm., rear wing 5.1 mm.

Holotype female: Rio Trinidad, Panama, Mar. 29, 1912, A. Busck (USNM).

21. *Auplopus blatteus*, new species

Holotype female. Clypeus black, head and thorax bluish with purple reflection; abdomen black, with brilliant bluish, violet and purplish reflection; antennae yellow beneath, brown above; a preapical band on mandibles and mouth parts bright yellow, apex of mandibles reddish; a very faint narrow yellowish line on anterior orbits just opposite antennae and extending about half way to foreocellus; forecoxae mostly yellow beneath, the last two pairs mostly black with tips yellow; foretrochanters mostly yellowish, last two pairs black; all femora and first two pairs of tibiae yellow, the last pair tibiae dark; foretarsi mostly yellow, the last two pairs yellowish below dark above; clypeus of usual shape, with a hairless, polished rim on apex broadest in middle; clypeus 2.0 as broad as long; ratio of lengths of third and fourth antennal joints is 14:12; upper interocular distance (15) just slightly less than the lower; head 1.2 as broad as long; foreocellus the largest, the laterals 1.5 as far from eyes as each other; wings hyaline, veins, and stigma yellow (wings teneral not fully developed).

Length head and thorax 5.0 mm., abdomen 3.6 mm.

Holotype female: Nicaragua (on banana), Aug. 25, 1933, J. Robins Wood, Mobile 1446 (USNM).

22. *Auplopus roseus*, new species

Holotype female. Clypeus black, head and thorax dull green with purplish reflection; abdomen black in certain light, with beautiful brilliant bluish and violet in other light; only slightly silvery haired on clypeus and face and only slightly more across apex of propodeum than elsewhere; only very few long hairs on body including the pro-

podeum; all femora, foretibiae, and midtibiae yellow; coxae and trochanters black, the latter with a little yellowish at apex; forebasitarsi yellow, rest of joints and last two pairs of tarsi black; mesonotum densely and closely punctured, the head more aciculate; antennae yellowish beneath, black above; ratio of lengths of third and fourth antennal joints is 13:11; upper interocular distance (17) slightly less than the lower; clypeus as usual, 2.0 as broad as long, a hairless polished rim on apex, much broader in middle; head 1.15 as broad as long; lateral ocelli not quite 2.0 as far from eyes as each other; wings hyaline, darker at tip, veins brown, stigma dark.

Length 8.0 mm.

Holotype female: On banana debris from Mexico, M.S. *Marimanian*, New Orleans, Oct. 11, 1934 (USNM).

23. *Auplopus nigriculus*, new species

Holotype female. Whole body a dull black; all femora, foretibiae and midtibiae beneath a bright yellow; midtibiae above, posterior tibiae, last four tarsal joints of foretibiae, all last two pairs tibiae, black; coxae a deep black, trochanters slightly lighter; very little silvery hair anywhere, only a few long hairs on propodeum; antennae brown beneath, dark above; clypeus of usual shape, 1.7 as broad as long; upper interocular distance (16) 0.9 the lower; head 1.1 as broad as long; lateral ocelli 1.5 as far from eyes as each other; ratio of length of third and fourth antennal joints is 17:14; wings hyaline, only very slightly dusky at apex, veins dark brown, stigma black.

Length 11.2 mm.

Holotype female: Barro Colorado Island, C.Z., June 14, 1939, Zetek 4453, lot no. 39–12571 (USNM).

24. *Auplopus lineatus*, new species

Holotype female. Clypeus black, head a very dark green (greenish hardly noticeable), sides and dorsum of thorax a dull, dark very noticeable green, propodeum slightly greenish, through the very dense white prostrate pubesence, which hides the surface; abdomen black with a reddish cast, especially at the apex of tergites, shining through the fine pubescence; face and clypeus densely sericeous; all the femora and foretibiae bright yellow; the midtibiae a darker yellowish mottled with black, especially on the inside and at apex on outside; posterior tibiae and all tarsi dark; mouth parts bright yellowish; mandibles reddish at apex, yellowish preapically; coxae and trochanters black (trochanters mottled with yellow); antennae with a narrow yellow line underneath, black above, the joints slightly larger at apex than at base of next joint; anterior orbits with a narrow

yellowish streak above the antennae, broadest above; clypeus of usual shape, with a broad hairless rim, not quite 2.0 as broad as long; head not quite as long as broad; eyes converging above, the upper interocular distance (16) only 0.8 as long as the lower; ratio of lengths of third and fourth antennal joints is 18:14; wings hyaline, veins brown, stigma black, hardly blacker at apex.

Length 12.0 mm.

Holotype female: Barro Colorado Island, C.Z., January–March 1944, Zetek 5125 (USNM).

Paratypes: 2, Barro Colorado Island, C.Z., January–March 1944, Zetke 5125 (USNM) (RRD); 1, El Cermeno, Panama, May 1939, Zetek 4435, lot no. 39–12208 (USNM); 1, La Providencia, Obispo, Guatemala, J. M. Aldrich (USNM); 1, Barro Colorado Island, C. Z., April–May 1942, J. Zetek, no. 4953 (USNM), 1, Tegucigalpa, Honduras, Aug. 18, 1917, F. J. Dyer, 29792 (USNM); the last paratype does not have the yellow mark on inner orbits.

25. *Auplopus quartus*, new species

Holotype female. Clypeus black, a hardly noticeable green; pronotum and scutellum black; abdomen black, no noticeable reflected colors; antenna black except basal joint slightly yellowish below; clypeus and face with prostrate silvery pubscence; the thorax with some light-colored inclined hair which gives it a rough appearance; coxae black, the forepair trochanters yellowish the last two pairs dark; all femora and foretibiae reddish yellow; forebasitarsi dark reddish, rest of joints, middle and hind tibiae and tarsi, dark; clypeus not quite 2.0 as broad as long; head 1.2 as broad as long; upper interocular distance (19) a little more than 0.8 the lower; antennae lost beyond third joint, length of third joint 20, on same scale as upper interocular distance; wings hyaline, slightly brownish, veins dark brown.

Length 11.9 mm.

Holotype female: Costa Rica (USNM).

26. *Auplopus venetus*, new species

Holotype female. Clypeus black, head and thorax with bright blue and purple colors; abdomen black in certain light with brilliant shining blue and purple colors in reflected light; antennae brownish beneath, black above; wings hyaline; all femora rufous, except knees of last two pairs are black; all tibiae, tarsi, and trochanters are black; coxae brilliant blue; clypeus 2.0 as broad as long; head as long as broad; ratio of lengths of third and fourth tarsal joints is 16:12; upper interocular distance (17) slightly less than the lower; lateral ocelli 1.5 as far from eyes as each other.

Length 10.2 mm.

Holotype female: Barro Colorado Island, C.Z., May 14, 1939, Zetek 4453, lot no. 12571 (USNM).

27. *Auplopus minusculus*, new species

Holotype female. Clypeus, face and inner orbits to above antennae black, this area contrasting with the not dense, silvery, prostrate, white pubscence, and the long hairs on apical half of clypeus; front and vertex shining green, with just a very faint purple iridescence; thorax green on dorsum and sides of thorax (except propodeum) rather bright green with purple nuance in reflected light; the dorsum and sides of propodeum purple with bluish reflection; scutellum and postscutellum black; abdomen a brilliant violet; wings hyaline, veins and stigma yellowish; antennae black, slightly brownish below; coxae violet, trochanters blackish suffused with yellow; femora and foretibiae yellow; middle and posterior tibiae and all tarsi black; clypeus as usual, a little more than 1.5 as broad as long; head 1.3 as broad as long; upper interocular distance (12) equal to lower; ratio of lengths of third and fourth antennal joints is 9:8; a very small species; the tip of abdomen lost.

Length about 6.0 mm.

Holotype female: Paraíso, C.Z., Panama, Feb. 7, 1911, August Busck (USNM).

28. *Auplopus magnus*, new species

Holotype female. Clypeus and face black with appressed, silvery pubescence; front, vertex, and thorax with dull greenish, with only the very faintest purplish tinge in certain light; coxae black (with bluish green reflection), foretrochanter yellow underneath, the others all black; all femora, foretibiae and foremetatarsal joint reddish yellow, the rest of legs dark; abdomen with violet and purple reflection; thorax with prostrate pubescence over most of surface; clypeus 1.6 as broad as long; ratio of lengths of third and fourth antennal joints is 22:17; upper interocular distance (20) is 0.9 the lower; head 1.3 as broad as long; lateral ocelli 2.0 as far from eyes as each other; wings hyaline, veins and stigma black.

Length 12.5 mm.

Holotype female: Costa Rica, October (USNM).

29. *Auplopus callainus*, new species

Holotype female. Head black; the whole thorax green, tending to a bluish green, shining, with no purple iridescence; abdomen black in certain light, with a brilliant blue reflection, with a faint trace of purple; clypeus and face with no silvery pubescence; thorax with considerable upright light-colored hair, especially on propodeum,

covered all over with fine silvery pubescence which only shows up in reflected light; coxae blue, trochanters dark, all femora and foretibiae reddish; the midtibiae reddish beneath, dark dorsally, rest of legs dark; the posterior tibiae with violaceous reflection on dorsal surface; ratio of lengths of third and fourth antennal joints is 13:10; the upper interocular distance (16) is equal to the lower; clypeus not quite twice as broad as long; head just slightly broader than long (16:15); lateral ocelli as far from eyes as from each other.

Length 8.6 mm.

Holotype female: Cano Saddle, Gatún Lake, Panama, May 3, 1923, R. C. Shannon (USNM).

30. *Auplopus buscki*, new species

Holotype female. The sides of clypeus and rest of head, and thorax bright blue green; abdomen with more bluish reflection, black in certain light; clypeus face and inner orbits to antennae strongly silvery sericeous, thorax covered with pubescence which is not as strongly silvery; abdomen pruinose; coxae blue green, trochanters black, yellowish beneath; all femora yellowish as well as first pair of tibiae; the femora with middle and posterior pair dark at base and the posterior pair dark on base and knees; posterior tibiae and all tarsi dark; antennae reddish beneath, black above; clypeus, on middle of apex, apex of mandibles and mouth parts, dull yellowish; clypeus with a polished rim, widest in middle, 2.0 as broad as long; ratio of lengths of third and fourth antennal joints is 16:13; upper interocular distance (16) equal to the lower; head 1.2 as broad as long; lateral ocelli a little more than 1.5 as far from eyes as from each other; wings hyaline, veins and stigma blackish.

Length 6.6 mm.

Holotype female: Trinidad, B.W.I., Aug. 1, 1921, August Busck (USNM).

31. *Auplopus medius*, new species

Holotype female. Clypeus black, rest of head and thorax green; abdomen, antennae, and legs black; except abdomen in certain light is slightly bluish and femora, coxae, and trochanters are strongly bluish in reflected light; clypeus 2.0 as broad as long; ratio of lengths of third and fourth antennal joints is 11:10; upper interocular distance (18) equals the lower; head 1.2 as broad as long; lateral almost 2.0 as far from eyes as each other; head and mesonotum finely, closely punctured; wings definitely brownish, clypeus and face strongly silvery sericeous; thorax with considerable long light-colored hair especially on propodeum.

Length 8.8 mm.

Holotype female: Zacapa, Guatemala, Bequaert (MCZ).

32. *Auplopus hidalgoensis*, new species

Holotype female. Clypeus black, rest of head dull faint greenish with a delicate purple iridescence; thorax about the same; abdomen with strong bluish and slightly purple coloration; antennae black; legs all black with blue reflection on femora and coxae; wings fuscous; ratio of third and fourth antennal joints is 12:10; pygidium not so smooth and shining as usual (partly telescoped).

Length 9.2 mm.

Holotype female: Guerrero Mills, Hidalgo, Mexico, W. M. Mann (MCZ).

33. *Auplopus fuscus*, new species

Holotype female. Head and abdomen black, no reflected colors; thorax bluish green with very strong purple reflection over almost whole surface; head and thorax with fairly long whitish hair; antennae black, slightly brownish beneath on apical half; coxae bluish, legs beyond black with no reflection; ratio of lengths of third and fourth antennal joints is 11:8.

Length 6.0 mm.

Holotype female: Santa Ana, Costa Rica, May 17, 1957, no. 718–285, PAB (USNM).

34. *Auplopus albifrons*, new species

FIGURES 24, 25

Holotype male. Front and vertex black; thorax back of pronotum black in certain light, greenish in other reflection; first segment of abdomen (except basal half of dorsal surface which is black) and about basal third of the second, and base of fourth, dull yellowish; rest of abdomen black; mouth parts, all the mandibles, the apex of posterior orbits, clypeus, face and the anterior orbits broadly to the foreocellus, yellowish white; apex of mandibles reddish; the first five joints of antennae yellowish above and below, brown from there to tip; pronotum and all of forelegs, yellowish, with the dorsal part of pronotum mottled with black, and the apical tarsal joints blackish; midlegs all yellowish (including coxae) except the last four tarsal joints are black; last pair coxae yellowish, with the outer sides black, rest of legs yellow except apical half of basitarsi and the apical four tarsal joints, which are blackish; the last tergite is black; fine, thinly placed, slighty golden pubescence on all of head which shows up strongly on black front and vertex, rather long whitish hairs on apical half of posterior orbits; the same slightly golden pubescence over whole thorax; wings hyaline, veins and stigma yellowish, with brilliant glistening yellowish reflection, in certain reflected light the cells are a beautiful bright green; first recurrent vein meets second

cubital cell about basal 0.35, the second meets third cell at basal 0.2; the basal and transverse veins in forewings and the subdiscoidal and cubitus in rear wings disjointed just about the length of the transverse vein; the basal five joints of antennae cylindrical, the rest increasingly to apex slightly concave beneath and convex above; ratio of lengths of third and fourth joints is 10:10; clypeus with the sides oblique, the apex 0.7 as wide as base, the width at base about 1.5 as long as length; rather wide, transparent rim across front edge of clypeus; head 1.1 as broad as long; upper interocular distance (13) equal to the lower; parameres of medium size for genus, the volsellae with a series of long hairs on inner sides from deep pores; subgenital plate with only a very short flat triangular surface at base, from its apex a sharp ridge extends to apex.

Length head and thorax 4.4 mm., abdomen 5.3 mm., forewing 6.7 mm., rear wing 4.6 mm.; length genitalia 0.86 mm., width 0.53 mm., length subgenital 0.86 mm., width 0.53 mm.

Holotype male: Rio Trinidad, Panama, Mar. 30, 1912, A. Busck (USNM).

Paratypes: 3, same locality as holotype, dates Mar. 17, 1912, Mar. 29, 1912, Mar. 6, 1912, A. Busck (USNM).

35. *Auplopus semirufus*, new species

FIGURES 22, 23

Holotype male. Body black with no color reflection, but various parts colored as noted; mandibles (except slightly reddish apex), clypeus, face, and broad inner orbits to just above antennae, white; lower, front, outside corners, of posterior edge of pronotum and fore-coxae, white; the other two pairs of coxae and rest of legs, except tarsal joints, reddish yellow; last joint foretarsi, last three joints midtarsi, and last four joints of last tarsi, dark; basal three segments of abdomen yellow above and below except a dark streak across dorsal surface of third; rest of abdomen black except the last tergite which is white; mouth parts dark yellowish; first joint antennae white beneath, reddish above, the next four or five joints slightly yellowish beneath, the dorsal surface of these and rest of joints black; antennae with all joints cylindrical, densely covered with short spines; head and thorax covered with a very delicate silvery pubescence, long white hairs under head and on propodeum; wings hyaline, not yellowish, veins and stigma yellowish, shining, with greenish reflection in reflected light; first recurrent vein meets second cubital cell at basal 0.4, the second recurrent meets second cubital at basal 0.4; basal vein in forewings basad of transverse by a little more than a third the length of latter; in rear wings subdiscoidal basad of cubital vein by almost length of transverse; clypeus with a narrow transparent

rim, the apex converging, 0.8 the length of base, 2.4 as broad as long; head 1.3 as broad as long; ratio of lengths of third and fourth antennal joints is 7:7; upper interocular distance (12) is equal to the lower; parameres not exceptionally wide with a rather narrow depression on outside at basal third; volsellae with a U-shaped opening at apex, very few hairs on inside and short hardly longer than aedeagus; subgenital plate with the basal triangular area extending beyond middle of plate, a narrow ridge extending from apex of triangle to apex of plate.

Length head and thorax 3.4 mm., abdomen 3.4 mm., forewing 5.3 mm., rear wing 3.6 mm.; length genitalia 0.33 mm., width 0.27 mm., length subgenital plate (and stem) 0.8 mm., width 0.33 mm.

Holotype male: 1, Arraiján, Prov. Panama, Panama, May 13, 1923, F. S. Blanton (USNM).

Paratypes: Acayucan, Vera Cruz, Mexico, Oct. 23, 1957, R. and K. Dreisbach (RRD); male, Palameres, Oaxaca, Mexico, Sept. 5–21. 1961, R. and K. Dreisbach (RRD).

36. *Auplopus abnormalis*, new species

FIGURES 12, 13

Holotype male. Head and thorax black, only very faintest greenish tinge; dorsum of pronotum and mesonotum metallic greenish, postscutellum and dorsum of propodeum bluish green, the scutellum black, sides of thorax brown (slightly reddish tint) and the sides of pronotum reddish; abdomen black with the apex of first tergite slightly yellowish; all coxae, trochanters, femora, and tibiae reddish yellow; forebasitarsi yellow, all the rest of tarsi dark; antennae yellowish beneath, except last three joints blackish, brown above; antennal joints cylindrical, except the apical three joints are abnormal (hence the name), they are broader than the rest and very flat, thin, and concave on surface; head and thorax with a delicate silvery pubescence; clypeus converging to apex, 0.8 as wide across apex as base, the apex wavy, a slight concavity each side of middle; clypeus 1.6 as broad as long; ratio of lengths of third and fourth antennal joints is 8:7; head 1.2 as broad as long; upper interocular distance (10) equal to lower; parameres more slender than usual, volsellae a little wider than usual; the groove on outside of parameres near base narrower and shallower; subgenital plate with the basal triangular surface extending to apical 0.75 of plate before closing, ridge sharp from there to apex.

Length head and thorax 3.3 mm., abdomen 4.0 mm., forewings 6.0 mm., rear wing 3.6 mm.; genitalia length 0.8 mm., width 0.33 mm., subgenital plate length 0.33 mm., width 0.26 mm.

Holotype male: Rio Trinidad, Panama, Mar. 19, 1912, A. Busck (USNM).

Paratype: Barro Colorado Island, June 14, 1939, Zetek 4453, lot no. 39–12571 (USNM).

37. *Auplopus niger*, new species

FIGURES 34, 35

Holotype male. Body including the coxae all black, except a short medium-wide white line on lower inner orbits (reaching from clypeus to base of antennae) and an obscure reddish mark at outer edge of clypeus; a small white spot in middle of apical tergite; all trochanters, femora, and tibiae reddish yellow; all of foretarsi (except apical joint, which is dark), and basal joint of midtarsi underneath reddish yellow, rest of tarsal joints dark; antennae yellow underneath, black above, the first eight joints cylindrical, the last five convex below in middle concave beneath at the joints; antennae slender, more so at tip; clypeus with a wide tooth (projection rather in middle of apical margin, concave each side; apical margin of clypeus 0.7 as wide as basal, 2.3 as broad as long in middle; head not quite 1.1 as broad as long; ratio of lengths of third and fourth antennal joints is 10:10; upper interocular distance (15) slightly greater than lower (13); wings hyaline slightly cloudy, veins and stigma brown, hardly yellow; parameres of genitalia rather broad, approaching the broadest in the genus, a pencil of five or six long hairs near base on surface on inner edge; a broad expansion near middle; volsellae broad; rather heavy short setae just before apical expansion.

Length head and thorax 3.4 mm., abdomen 3.4 mm., forewings 5.3 mm., rear wings 3.6 mm; length genitalia 0.80 mm., width 0.53 mm., length subgenital 0.93 mm., width 0.4 mm., subgenital plate with the basal triangle open to the apical fourth, the ridge extending from there to apex.

Holotype male: San José, Costa Rica, 1928, M. Valerio 146 (USNM).

38. *Auplopus woodi*, new species

FIGURES 20, 21

Holotype male. Front, vertex, and posterior orbits, black; dorsum and sides of thorax to the propodeum black with a faint bluish color, with slight purplish reflection; dorsum and sides of propodeum with stronger bluish color and purple reflection; abdomen blackish with tergites 2 to 5 with the posterior edges narrowly whitish, the last tergite white; basal tergite with the sides yellowish; forecoxae all yellow, midcoxae black on base, rest yellowish and posterior coxae black; first two pairs trochanters yellow, posterior pair black with

apex slightly yellowish; all femora and first two pairs tibiae yellow, as well as most of foretarsi; two posterior tibiae and last two pairs tarsi dark; mouth parts, middle half of mandibles, clypeus, face and broad inner orbits half way from antennae to foreocellus, white; apex of mandibles reddish, base black; clypeus with a narrow transparent edge, truncate in front; clypeus with apical margin 0.8 as wide as base, 2.5 as broad as long; ratio of lengths of third and fourth antennal joint is 6:6; head 1.4 as broad as long; antennae yellowish below, brown above; wings hyaline, veins and stigma yellowish; parameres more typical of those of the nearctic species, very short, very broad, the section apicad of cross line about equal in length to the basal section; the broad protuberances at base of parameres not horizontal (as is generally the case) but at an angle of about 45°, broader than usual; a very few long hairs on outside edge of volsellae, whole genitalia with less hairs than usual; parapenial lobes and aedeagus broader than usual; raised triangle on base of subgenital plate closed at basal fourth, a sharp ridge extending from there to apex, fewer setae around base than usual.

Length of head and thorax 3.0 mm., abdomen 3.0 mm., forewing 5.3 mm., rear wing 3.3 mm.; length genitalia 0.66 mm., width 0.40 mm., length subgenital plate 0.73 mm., width 0.43 mm.

Holotype male: With Zephyranthus bulb, Mexico, W. B. Woods, Apr. 30, 1935, E.Q., 035734 (USNM).

39. *Auplopus anthracinus*, new species

FIGURES 32, 33

Holotype male. Body black, abdomen with sides slightly yellowish; all coxae black, foretrochanters black above, yellowish beneath, the last two pairs trochanters black; forefemora and tibiae reddish yellow; midfemora reddish with base black, midtibiae reddish beneath, blacker above; posterior femora with basal third black, knees also black, tibiae black; basal joint of forebasitarsi slightly yellowish, the rest of foretarsi and all of middle and posterior tarsi black; antennae yellowish beneath, black above (joints beyond ninth lost); apical edge of clypeus slightly wavy, slightly produced in center and slightly concave each side, a very narrow rim, which is hairless and opaque; face and clypeus silvery, the underside of head and thorax with long rather shaggy looking hair; clypeus with apical margin 0.8 as broad as base, 1.8 as broad as long; head a little less than 1.2 as broad as long; ratio of lengths of third and fourth antennal joints is 10:9; upper interocular distance (14) is equal to the lower; wings hyaline, veins and stigma dark; the basal vein in forewing almost interstitial with transverse, apicad of transverse by the diameter of a vein; in

rear wings the subdiscoidal and cubital are disjointed about the same distance; about apical half of parameres lost, of medium size; other parts of genitalia short, volsellae and parapenial lobes equal in length, aedeagus shorter.

Length head and thorax 4.3 mm., abdomen 4.8 mm., forewing 7.9 mm., rear wings 5.6 mm.; length genitalia ? mm., width 0.53 mm., length subgenital 0.93 mm., width 0.53 mm.

Holotype male: Barro Colorado Island, C.Z., June 14, 1939, Jas. Zetek 4453 (USNM).

40. *Auplopus clypeatus*, new species

FIGURES 10, 11

Holotype male. Face and clypeus, black, front and vertex black with a trace of dark greenish color; pronotum, sides of thorax and sides of propodeum black, the dorsum of thorax and propodeum a coppery green; abdomen black with sides of first tergite yellowish; inner orbits from clypeus to just above antennae broadly white; apex of mandibles reddish, mouth parts brown, first four joints of antennae reddish yellow, rest lost; coxae all black, foretrochanters yellow, last two pairs black; all femora and tibiae yellow, the basal joints of all tarsi yellow except apex of last two pairs darker; last two joints of foretarsi and last four joints of middle and hind tarsi, dark; about the middle third of clypeus projecting beyond the sides, each side rather deeply concave, the front edge of clypeus thickened; the clypeus and face strongly silvery sericeous; clypeus slightly more than 2.0 broad as long; ratio of lengths of third and fourth antennal joints is 10:10 upper interocular distance (12) equal to the lower; head 1.2 as broad as long; wings hyaline; veins and stigma yellow; the basal vein in forewings basad of transverse by about 0.75 the length of latter, in rear wings the subdiscoidal basad of cubital by about same length; parameres of genitalia of the broad heavy type, somewhat acute at apex, free of hair except a few at apex; volsellae short and the apex with more of a V-shaped concavity instead of the more general U-shaped type; parapenial lobes slender on basal 0.75 with the apical 0.25 much broadened; subgenital plate with the raised basal triangular surface very broad at base, the triangle closed about apical fourth, a narrow ridge from there to apex.

Length head and thorax 4.0 mm., abdomen 4.0 mm., forewing 6.3 mm., rear wing 4.6 mm.; length genitalia 0.93 mm., width 0.53 mm., length subgenital plate 0.93 mm., width 0.55 mm.

Holotype male: Tegucigalpa, Honduras, Feb. 22, 1918, F. J. Dyer, 37074 (USNM).

41. *Auplopus aeruginosus*, new species

FIGURES 18, 19

Holotype male. Clypeus and face slightly reddish tinted, the outer edges of clypeus with an obscure whitish mark; head dull metallic green, the dorsum of thorax with a much brighter shining green, sides of thorax black with a very slight greenish tinge; abdomen black, with a light yellowish streak on sides of first tergite; first two joints of antennae yellow above, the first three yellow below, rest of joints black; joints of antennae cylindrical for first seven or eight joints but the rest slightly concave at joints; interior orbits with a rather broad yellowish band from clypeus to just above antennae; mouth parts slightly yellowish; all coxae a dark rufous, shining; all trochanters, all femor and foretibiae, yellow; tibiae of middle and hind legs dark, lighter underneath and yellowish at apex; tarsi all dark; wings hyaline; the basal vein basad of transverse, in forewings, by less than length of transverse, the veins in rear wings disjointed about same amount; clypeus with a hairless rim in middle of front margin 0.6 length of margin, each side of this extension the margin is slightly concave, the clypeus does not extend under eyes; clypeus 1.5 as broad as long; ratio of lengths of third and fourth antennal joints is 9:9; upper interocular distance (12) equal to the lower; head as broad as long; body covered with a slight, silvery and upright pubescence; parameres of genitalia very narrow for the genus, about 1.5 as long as volsellae; volsellae with a long concavity at apex; subgenital plate with a medium width triangular area at base extending to about middle of plate, a sharp ridge from there to apex.

Length head and thorax 3.6 mm., abdomen 3.3 mm., forewings 6.6 mm., rear wings 5.2 mm.; length genitalia 0.66 mm., width 0.33 mm., length subgenital plate 0.66 mm., width 0.26 mm.

Holotype male: Rio Trinidad, Panama, Mar. 16, 1912, A. Busck, P-14 (USNM).

42. *Auplopus argentinus*, new species

FIGURES 8, 9

Holotype male. Clypeus and face faded white, on outer third so densely covered with prostrate silvery pubescence that the integument is hardly visible (only in certain light); front above antennae not quite half way to foreocellus a shining green, rest of front behind it and the vertex a shining black; in higher magnification (75x) appearing rough by reason of the very fine dense punctures; dorsum of thorax and posterior half sides black, only the sides of thorax in front of forewing greenish; the surface of mesonotum similar to head; abdomen black, apex of last tergite white, sides of first tergite yellowish; first pair coxae yellow, second pair yellow with a black streak on upper outer

edge, the third pair black with ventral surface yellow; foretrochanters yellow, second pair yellowish suffused with black, last pair black; first two pairs femora yellow, posterior pair black at base and apex; foretibiae yellow, rest black; foremetatarsal joints dark yellowish, rest of foretarsi dark; all last two pairs tarsi dark; wings hyaline, veins and stigma very dark yellowish; two-thirds of apical margin of clypeus in the middle with edge straight the outer front corners with an expanded, transparent lip or broad tooth which extends forward, making the front margin a concavity with the inner edge straight, with a narrow rim; clypeus 2.0 as broad as long; antennae lost after third joint, yellow beneath, black above; relative length third joint is 10; upper interocular distance (14) slightly greater than the lower (12); head 1.25 as broad as long; very little pubescence anywhere except clypeus and face; parameres of medium size for genus, rather long, 2.0 as long as volsellae; volsellae with concavity as apex rather shallow; parapenial lobes rather broad, almost as broad below as near apex; subgenital plate with the basal triangle very narrow at base, closed about apical fourth; sixth sternite with an apical, triangular projection in middle of the deeply concave apex.

Length head and thorax 4.6 mm., abdomen 3.0 mm., forewings 7.0 mm., rear wings 5.3 mm.; genitalia length 0.90 mm., width 0.53 mm., length of subgenital plate 1.12 mm., width 0.40 mm.

Holotype male: Barro Colorado Island, C.Z., Apr. 5, 1939, Zetek 4420, lot no. 39–11659 (USNM).

43. *Auplopus marginalis*, new species

FIGURES 26, 27

Holotype male. Clypeus and face with 0.67 of the clypeus white on outer edges about 0.33 in the middle brown; inner orbits broadly white from clypeus to antennae from where the white reduces to a point half way to foreocellus; front, vertex, and dorsum of thorax (except postscutellum, which is black) a blue green, with purple reflection; sides of thorax more greenish colored; abdomen black, the first tergite with a slightly yellowish streak in middle of sides, and the apical tergite, white; antennae reddish yellow below, black above; forecoxae yellowish (black at base), the last two pairs greenish; foretrochanters yellow, middle pair yellow with a little black, last pair black; all femora yellow, foretibiae yellow, midtibiae yellow beneath dark above, last tibiae all dark; metatarsal joint of forelegs yellow, last four joints dark; all tarsi of last two pairs dark; clypeus with a very broad transparent rim across the whole truncate front margin and the side pieces; clypeus not quite 2.0 as broad as long; head 1.3 as broad as long; ratio of lengths of third and fourth antennal joints is 9:9; upper interocular distance (13) slightly greater than lower

(12); clypeus and face strongly silvery pubescent, thorax not so strongly so, the latter rather rough-looking from the straggly upright hair; wings hyaline; parameres rather broad; volsellae with fairly long hairs on inner edge; aedeagus emarginately notched at apex; subgenital plate with basal triangle closed about middle of plate, the apical half with a very thin sharp ridge to apex.

Length head and thorax 4.0 mm., abdomen 3.3 mm., forewing 6.3 mm., rear wing 4.6 mm.; length genitalia 1.00 mm., width 0.53 mm., length subgenital plate 0.66 mm. (without stem), width 0.26 mm.

Holotype male: From Mexico at light in hold, W. J. Ehringer, Aug. 10, 1934, Philadelphia 24134 (USNM).

Paratypes: Mexico, banana debris, Oct. 29, 1936, lot no. 36–34294 (USNM); 3, Costa Rica, banana debris, May 11, 1936, New York 59336 (USNM) (RRD); 1, Mexico, banana debris, May 11, 1936, New York, lot no. 59338 (USNM); 1, Mexico, banana debris intercepted at Mobile, Sept. 4, 1932, Mobile 846 (USNM); 1, banana trash Dec. 19, 1935, New Orleans, 14936 (USNM).

44. *Auplopus atratus*, new species

FIGURES 40, 41, 76

Holotype male: Edges of clypeus and face white for more than 0.67 of their width, brown in middle 0.33; inner orbits broadly white on face and narrowing to a point on front just above antennae; front vertex, thorax and abdomen black, except apical tergite is white on about middle; a narrow white stripe across base of third tergite; black on head and thorax opaque, abdomen shining; forecoxae yellowish beneath, on dorsal surface and sides with a black stripe in middle of latter; last two pairs coxae shining black; foretrochanters yellow, middle pair yellow suffused with black, last pair black with some yellow beneath; all femora and tibiae reddish, the posterior femora black at base; basal tarsal joint all yellowish (foretarsi) or yellowish beneath and dark above (last two pairs), rest of tarsi dark; mandibles with apical half yellowish, mouth parts brown; thorax with upright hair all over thin, neither head nor thorax with much silvery pubescence; wings hyaline, slightly dark, darker at apex; clypeus in a smooth curve across apex, concave in middle with a medium transparent rim, narrowest in middle; clypeus 2.3 as broad as long; basal antennal joint white beneath, rest of antennae only slightly yellowish beneath and black above; ratio of lengths of third and fourth antennal joints is 9:9; upper interocular distance (14) equal to the lower; head 1.3 as broad as long, parameres rather long and more slender than usual, a few long hairs on apical half, about twice as long as volsellae; volsellae broad with more hairs than usual; parapenial lobes slender, of about equal width over whole length; aedeagus rounded at apex; subgenital at

apex; subgenital plate with triangle closed a little above middle, a sharp ridge from there to apex.

Length head and thorax 4.0 mm., abdomen 4.6 mm., forewing 7.3 mm., rear wing 4.6 mm.; length genitalia 0.80 mm., width 0.53 mm., subgenital plate length 0.8 mm., width 0.40 mm.

Holotype male: Río Blanco, Vera Cruz, Mexico, Nov. 13, 1957, R. and K. Dreisbach (USNM).

45. *Auplopus amoenus*, new species

FIGURES 38, 39

Holotype male. Clypeus and face black except for a white streak on outer edges, continuing on inner orbits to above antennae; head greenish with black reflection, dorsum of thorax a brighter greenish, the sides of thorax more black with only green color in grooves on side of thorax; abdomen black, except third tergite is reddish and apical tergite has a white spot in center; all femora and tibiae rufous, except last pair of femora is black at base; basitarsi of forelegs rufous, rest of joints and all joints of last two pairs of tarsi are black; antennae wholly black, except first joint is whitish beneath; clypeus slightly concave across apex, with the sides thin almost transparent and projecting forward slightly at apex, a slight convexity on middle of clypeus in center; clypeus extends under eyes slightly; clypeus 2.0 as broad as long; head 1.25 as broad as long; ratio of third and fourth antennal joints is 11:11; upper interocular distance (15) equal to the lower; wings hyaline, slightly dark, apex darker, veins and stigma black; basal veins in forewing disjointed not qute 0.5 the length of transverse; the cubital and subdiscoidal in rear wings interstitial; parameres of genitalia rather slender, short hairs on inner edge and surface, rather acute; volsellae with the apical outer flange raised above side pieces.

Length head and thorax 4.3 mm., abdomen 4.3 mm., forewing 7.3 mm., rear wing 6.6 mm.; length genitalia 0.93 mm., width 0.46 mm., length subgenital plate 0.93 mm., width 0.46 mm.

Holotype male: Xilitla, Mexico, July 21, 1954, R. R. Dreisbach (USNM).

46. *Auplopus vulcanensis*, new species

FIGURES 28, 29

Holotype male. Clypeus black, face and head black with a faint trace of greenish; dorsum of thorax green, the color becoming stronger from pronotum to propodeum, the apical third of propodeum with strong purple reflection; the sides of thorax about same color as propodeum but slightly more bluish green, except the furrows are black; abdomen black with slight bluish reflection, the basal tergite slightly rufous on sides and apical edge of tergites semitransparent and slightly

rufous, with considerable fine white, appressed pubescence; a narrow white line on anterior orbits from clypeus to antennae; first joint of antennae almost white beneath, rest of antennae yellow beneath slightly very dark reddish above in reflected light; legs all black; head and thorax with a mixture of white appressed pubescence and upright hair, giving it a rather shaggy look; propodeum strongly whitish pubescent on apical fourth; first tergite and second sternite with upright hair and all femora with long hair on ventral surface; clypeus with a semitransparent rim across apex which is much wider at outer corners making the front edge concave in center, the opaque part straight across; third and fourth antennal joints equal in length (17); a rather large heavy-bodied insect yet antennae very slender, cylindrical; clypeus 2.0 as broad as long; upper and lower interocular distances equal (20); head as broad as long; lateral ocelli 1.5 as far from eyes as from each other; wings hyaline, very slightly darkened in reflected light, tip of wing not darker; wing veins and stigma yellow; parameres of genitalia narrow for the genus and rather sharp pointed, the ridge near middle curved; the apex of volsellae generally, somewhat rectangular; parapenial lobes rather wide; subgenital plate with a small basal triangle which is closed near middle of plate, broader for length than usual.

Length head and thorax 6.3 mm., abdomen 4.7 mm., forewing 9.9 mm., rear wing 7.0 mm.; length genitalia 1.13 mm., width 0.66 mm., length subgenital plate 1.13 mm., width about 0.6 mm.

Holotype male: Volcán, Colima, Mexico, 1913, Joh. Lane (Munich Mus.).

47. *Auplopus gaumeri*, new species

FIGURES 30, 31

Holotype male. Clypeus and sides of face black, the middle of face just below antennae bluish green; rest of head bluish green with purple reflection; thorax bluish green (not as strongly colored as head) with purple reflection; abdomen brownish, sides slightly yellowish, especially the first tergite, reflecting an obscure violet, slightly pruinose; antennae yellow (lost after third joint); legs all yellow beyond trochanters, the latter slightly yellowish beneath; clypeus and face with appressed sericeous pubescence, long hairs under head, the rest of body with very little pubescence, except propodeum slightly pubescent on outer edges; apical edge of clypeus thickened, and a notch each side of middle; clypeus 2.5 as broad as long; length third antennal joint is 16 (same scale as usual); upper and lower interocular distance about equal; head 0.9 as long as broad; parameres of genitalia of very large size, the width of one of them equal to the width of the whole base of genitalia; the cross-ridge or septum of the parameres located

well above apex of volsellae, the apex large and blunt; parapenial lobes narrow for size of genitalia; a rather heavy row of spines on upper inside edge of volsellae.

Length head and thorax 5.6 mm., abdomen 6.0 mm., length forewing 8.9 mm., rear wing 6.6 mm.; length genitalia 1.4 mm., width 1.13 mm., length subgenital plate 1.2 mm., width 0.066 mm.

Holotype male: Yucatan, G. F. Gaumer (USNM).

48. *Auplopus kathryni* new species

Holotype female. Head and thorax greenish or bluish green with very strong purple reflection, abdomen a deep dark blue; legs all black, coxae bluish in reflected light; antennae black; clypeus and face sericeous pubescent, the head, thorax, and especially the propodeum with long white, upright hair; first tergite long-haired on dorsal surface; middle of clypeus extending forward in a slight hairless rim, the front edge convex, surface in middle of clypeus raised; clypeus 2.0 as broad as long; ratio of lengths of third and fourth antennal joints is 11:10; upper and lower interocular distance equal (16); head not quite 1.2 as broad as long; lateral ocelli almost 3.0 as far from eyes as each other; wings hyaline; first recurrent vein meets second cubital cell just beyond middle, the second recurrent vein meets third cubital cell at basal fourth; veins and stigma very dark yellowish.

Length head and thorax 4.0 mm., abdomen 3.4 mm., forewing 7.0 mm., rear wing 5.2 mm.

Holotype female: Lagos de Moreno, Mexico, Aug. 12, 1954, R. R. Dreisbach (USNM).

Paratype female: Valle de Santiago, Mexico, May 26, 1956, R. Iglesias (Monterey University).

This species is named for Mrs. Dreisbach who has collected some of the new species described in this paper.

49. *Auplopus fulgidus*, new species

Holotype female. Head and thorax an opaque black, the abdomen a bright shining black, no trace of reflected color; mandibles black except the reddish apex, the palpi light yellow, the antennae black, slightly brownish beneath; coxae and trochanters black except the last pair has trochanters slightly yellowish beneath; all femora, tibiae and basitarsi of all legs a reddish yellow; long whitish hair under head on propodeum and on apical half of abdominal sternum; the upright hair on front and vertex is white; no rim on front margin of clypeus the margin truncate not extended in middle as usual; clypeus not quite 2.0 as broad as long; ratio of lengths of third and fourth joint antennae is 14:11; upper interocular distance (16) not quite equal to the lower (18); head 1.15 as

broad as long; lateral ocelli only 1.3 as far from eyes as each other; wings hyaline, slightly dark, very slightly darker at apex; first recurrent vein meets second cubital cell in center, and the second recurrent meets third cubital in center; veins of wings almost black.

Length head and thorax 5.3 mm., abdomen 5.3 mm., forewings 9.6 mm., rear wings 6.4 mm.

Holotype female: Xilitla, San Luis Potosi, Mexico, July 23, 1954, R. R. Dreisbach (USNM).

50. *Auplopus dietzi*, new species

Holotype female. Completely black, with no visible color except abdomen is slightly brownish; head and thorax dull, abdomen shining; mandibles black with reddish tip, palpi brown at base yellow at apex; coxae and first two pairs trochanters black, last pair trochanters yellowish beneath at apex; forefemora reddish on inside and at apex, the last two pairs all reddish; all tibiae and tarsi black; antennae yellowish beneath beyond second joint, brown above; head, thorax and apical half of abdominal sternum pubescent; a hairless reddish, translucent rim around the whole front margin and sides of clypeus, widest in the middle where it projects in the usual manner; clypeus raised in middle of surface and 1.66 as wide as long; head a little more than 1.1 as broad as long; ratio of lengths of third and fourth antennal joints is 15:12; upper interocular distance (16) equal to the lower; lateral ocelli 2.0 as far from eyes as each other; wings hyaline, first recurrent vein meets second cubital cell about the middle and the second recurrent meets third cubital cell beyond basal fourth; wings slightly darker at apex.

Length head and thorax 4.6 mm., abdomen 4.0 mm., forewing 8.6 mm., rear wing 6.3 mm.

Holotype female: Ancón, Canal Zone, August 1919, G 161, H. F. Dietz (USNM).

51. *Auplopus minutus*, new species

Holotype female. Clypeus and face black, rest of head dull greenish blue; dorsum of thorax (except propodeum) about the same color as head, both with a faint purplish iridescence; the propodeum and sides of thorax with a much brighter greenish blue color with only the faintest purplish cast; abdomen a shining blue; upright hair on vertex and front black; clypeus projecting forward at apex in center more than usual, a hairless translucent rim around front edge; clypeus 1.7 as broad as long; ratio of lengths of third and fourth antennal joints is 8:8; head 0.9 as long as broad; upper interocular distance (14) equal to the lower; lateral ocelli 2.0 as far from eyes as each other; wings hyaline very slightly darker at tip; first recurrent vein meets the second

cubital cell about the middle, the second recurrent vein meets third cubital cell at basal 0.35; veins and stigma dark.

Length head and thorax 3.0 mm., abdomen 3.3 mm., forewing 5.4 mm., rear wing 4.0 mm.

Holotype female: Río Blanco, Vera Cruz, Mexico, Nov. 13, 1957, R. and K. Dreisbach (USNM).

52. *Auplopus bequaerti*, new species

FIGURES 16, 17

Holotype male. Head and thorax bluish green; abdomen brown, slightly yellowish on sides of first tergite and on ventral segments; clypeus, face, broad anterior orbits (touching antennae) to just above antennae, femora except base, ventral side of forecoxae, and trochanters and rest of front pair legs, except last three tarsal joints, light yellow; posterior orbits wholly black, mesonotum almost black; antennae brown above, yellow beneath, very slender, joints cylindrical; basal half of mandible black, apical half yellow; the outer front edges of clypeus projecting forward beyond the middle front edge; clypeus 2.0 as broad as long; upper interocular distance (12) just barely greater than the lower; head 1.1 as broad as long; ratio of length of third and fourth antennal joints is 8:7; lateral ocelli a trifle less than 2.0 as far from eyes as from each other; clypeus and face strongly silvery sericeous, thorax not nearly so pubescent, a few long whitish hairs on head and thorax; wings hyaline, veins and stigmae yellowish; parameres of genitalia broad and short, no cross-ridge on them at any place; subgenital plate narrow, the basal triangle open almost to apex.

Length head and thorax 4.0 mm., abdomen 3.7 mm., forewing 6.6 mm., rear wing 4.3 mm.; length genitalia 0.80 mm., width 0.73 mm., length subgenital plate 0.73 mm., width 0.37 mm.

Holotype male: Sta. Emilia, Pochuta 1,000 M., Guatemala, February and March 1931, J. Bequaert (MCZ).

53. *Auplopus gertschi*, new species

FIGURES 6, 7

Holotype male. Most of head, all of thorax and all of abdomen black (abdomen with brownish cast, the first tergite almost yellow on sides); the outer 0.67 of clypeus and face, the anterior orbits (extending from eyes to base of antennae) to above antennae, white; mandibles black, with apex reddish; mouth parts brownish; antennae yellowish beneath (becoming more black toward apex), brown above; forecoxae and trochanters yellow, the last two pairs black; all femora reddish; foretibiae and first two tarsal joints yellow, last three joints brown; last two pairs of legs black beyond femora, but tibial spurs mostly reddish; clypeus thin on anterior rim but appearing thickened, the

thickened part, however, recessed behind rim, concave on anterior edge; clypeus 2.0 as broad as long in middle; head 1.2 as broad as long; ratio of third and fourth antennal joints is 10:10; upper and lower interocular distances equal (14); lateral ocelli 2.0 as far from eyes as each other; dorsal part of pronotum very short; wings hyaline, slightly yellowish, veins and stigma yellow; basal vein in forewings basad of the transverse by a half length of the latter; cubitus in rear wings apicad of subdiscoidal vein by same distance as above; parameres of genitalia of medium width; volsellae exceptionally broad.

Length of head and thorax 4.6 mm., abdomen 3.7 mm., forewing 8.0 mm., rear wing 5.3 mm.; length of genitalia 0.93 mm., width 0.8 mm., length subgenital plate 0.93 mm., width 0.53 mm.

Holotype male: Barro Colorado Island, C.Z., Panama, Feb. 10, 1936, W. J. Gertsch (AMNH).

54. *Auplopus hondurensis*, new species

FIGURES 1, 2

Holotype male. Clypeus, face, posterior orbits, and coxae black; front, vertex, and mesonotum dull greenish; sides of thorax and propodeum almost black but in certain reflected light appears a dull bluish green in places, much less than on mesonotum; mandibles almost all black, slightly reddish at apex; mouth parts brown; abdomen dark, slightly brownish especially on sides of first tergite; all trochanters, femora, and at least first two pairs tibiae, reddish (last pair tibiae lost); foretarsi reddish except last three joints are dark (last two pairs lost); first three joints antennae yellow beneath, brown above (rest joints lost); inner orbits narrowly white to just above antennae; clypeus thickened on front edge, strongly concave each side of middle in front; clypeus 2.25 as broad as long; head about 1.25 as broad as long; interocular distance 0.59 of the transfacial; lower interocular distance 0.9 the upper interocular (18); length third antennal joint 14 on same scale as measurement of upper interocular distance; lateral ocelli 2.0 as far from eyes as each other; face and clypeus silvery pubescent; thorax not nearly as silvery pubescent as face, but has rather long upright hair (as has the head) which gives it a rather shaggy appearance; wings hyaline, veins and stigma black; basal vein in forewings basad of transverse by 0.5 the length of latter; genitalia and subgenital plate very much like that of *clypeatus*, and of about same size, but the size of insect is larger and the various measurements are different.

Length of head and thorax 4.6 mm., abdomen ?, forewing 8.3 mm., rear wing 5.9 mm.

Holotype male: Zamorano, 20 mi. from Tegucigalpa, Honduras, T. D. A. Cockerell (MCZ).

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Paratype male: Volcán, Colima, Mexico, 1918, Joh. Lane (Munich Mus.).

55. *Auplopus hispidus*, new species

Holotype female. Clypeus and abdomen black, except that clypeus has a slight bluish tint; head (except clypeus), and all of thorax bluish green; coxae about same color as thorax, trochanters black; clypeus, face and inner orbits silvery sericeous, the thorax also covered with appressed silvery pubescence but it does not obscure the integument as does that on clypeus and face; head and thorax (and ventral segments to a lesser degree) with long, shaggy, whitish pubescence; mandibles black except for a preapical yellowish spot; antennae yellow beneath, brown above; clypeus of usual shape, thin in front and not quite 2.0 as broad as long; ratio of length of third and fourth antennal joints is 14:11; ratio of length of upper interocular distance to the lower is 15:16; middle interocular distance a little less than 0.6 the transfacial distance; head 1.1 as broad as long; lateral ocelli not quite 2.0 as far from eyes as each other; wings hyaline, veins and stigma yellowish; first recurrent vein in forewings meets the second cubital cell in middle, the second recurrent meets third cubital cell about basal third; in certain reflected light the wings have a brilliant greenish iridescence; all femora and first two pairs tibiae reddish, last pair tibiae and all tarsi dark.

Length of head and thorax 6.3 mm., abdomen 4.6 mm., forewing 7.6 mm., rear wing 5.4 mm.

Holotype female: El Salto, Escuintla, Guatemala, June 28, 1934, F. X. Williams (MCZ).

56. *Auplopus bermudensis*, new species

Holotype female. Completely black, except apex of mandibles are slightly reddish; numerous whitish hairs on body, especially under head, coxae, apical half of propodeum, underside of coxae, thorax, and ventral part of abdomen; clypeus strongly rounded in front, bulging when seen from the side, extending under eyes slightly, about 2.0 as broad as long; middle interocular distance 0.57 the transfacial; lower interocular distance (80) is slightly less than the upper (90); head very broad, 1.2 as wide as long; ratio of lengths of first four antennal joints is 40:15:55:50; lateral ocelli not quite 2.0 as far from eyes as from each other; pronotum slightly angulate behind; wings fuscous; the first and second recurrent veins meet the second and third cubital cells respectively at middle and basal third.

Length head and thorax 4.0 mm., abdomen 2.70 mm., forewing 6.6 mm., rear wing 5.1 mm.

Holotype female: Bermuda Biol. Sta., Mar. 13, 1935, H. Osborn (USNM).

II. SOUTH AMERICAN SPECIES

(Species 57–81)

Key to Species from South America

FEMALES

1. Basal segment of abdomen yellowish or the whole abdomen red or yellow . 2
   Neither the basal segment of abdomen, nor the whole abdomen red or yellow 4
2. Only basal segment of abdomen yellowish; legs yellowish except tips of tarsi and forecoxae. Ecuador . . . . . **mendicus** (Banks)
   The whole abdomen yellowish or reddish; coxae and rest of legs rufous or yellowish, except apical tarsal joints may be black 3
3. Whole abdomen reddish; coxae and rest of legs same color except last tarsal joint of forelegs and the last three joints of last two pairs are blackish; abdomen and head bluish green with purple reflection; a strong hair brush on mentum, but not a strong pygidial area; antennae yellowish below, brown above. Amazon . . . . . **79. pygidialis,** new species
   The whole abdomen a slightly lighter reddish; legs as in *pygidialis* except only apical tarsal joint blackish; the whole head except ocellar triangle yellow; the whole thorax yellow, except a streak across the neck, most of dorsum of mesonotum and propodeum and postscutellum are black; scutellum is mostly yellowish; pygidial area slightly stronger than above; antennae yellow above and below on the first four and a half joints. Amazon. **58. ferrugineus,** new species
4. Head, thorax, or propodeum bluish or greenish 5
   Neither head, thorax or propodeum greenish or bluish 25
5. Clypeus yellowish with a black spot in middle the yellowish extending up each side 6
   Clypeus black or apical half dull reddish 13
6. Legs with the femora reddish or yellowish, often patches of pale hairs on hind corners of propodeum 7
   Legs wholly black; propodeum usually striate all over 10
7. Propodeum minutely striate across middle base, coarsely punctate behind; a distinct median furrow; midtibia pale, basal segment of abdomen plainly hairy above. British Guiana, Brazil . . . . . **tarsatus** (Smith)
   Propodeum at middle base not striate across; median furrow not so distinct or none 8
8. Appressed pubescence of head and thorax rather dull yellowish, not snow white; head and thorax usually greenish; all femora and tibiae yellowish. Colombia . . . . . **viridis** (Smith)
   Appressed pubescence is snow white 9
9. Front femora largely black and tibiae partly so, abdomen bluish to violet; middle and hind femora black at one end; both recurrent veins end before middle of cell. British Guiana . . . . . **wheeleri** (Banks)
   Front femora and tibiae wholly yellowish; propodeum punctate behind. Brazil, British Guiana, Trinidad . . . . . **femoratus** (Fabricius)
10. Very hairy, long white hair on clypeus and front, on propodeum behind and on first segment of abdomen above and below; wings rather smoky, not black; abdomen black, thorax broad. Colombia, Ecuador. **robustus** (Banks)

Much less hairy; clypeus and front not noticeably hairy; basal segment of abdomen with extremely minute if any hair; wings often evenly blackish 11

11. Wings hyaline, no dark bands, stigma black, basal joint of antennae yellowish above and below; face and clypeus with short, golden appressed hair. Colombia. . . . . **paniquitus** (Banks)

Not so 12

12. Head and thorax but little bluish; abdomen shining black; inner spur of hind tibia one-half of basitarsus. Peru . . . . . **peruanus** (Banks)

Head, thorax, and abdomen strongly bluish, iridescent on abdomen; inner spur of hind tibia not one-half of basitarsus. Peru.

caeruleosomus (Banks)

13. Legs entirely black, with bluish reflection; whole body bluish with brilliant purple reflection; wings black; propodeum rather strongly, transversely rugose across the dorsal and posterior surface. Peru.

67. striatus, new species

Legs not entirely black, if blackish, without rufous color and wings not black; except in one case with middle or posterior coxae or both rufous. . . 14

14. Legs blackish, with lighter bluish or yellowish tint; forewing with the front part of wing back through the cubital cells much darker than (dark yellowish) the posterior part of wing which is hyaline; body not with purplish reflection. Amazon. . . . . **66. alarius,** new species

Some part of legs with rufous color 15

15. The apical 0.65 of forefemora and the foretibiae rufous; base of forefemora and rest of legs black; antennae yellowish. Amazon.

60. batesi, new species

Either middle or posterior femora or both rufous 16

16. Femora not wholly rufous, front pair with only apical 0.3 rufous, the last two pairs with only apical 0.75 rufous and knees black, the rest black; foretibiae rufous, all the rest of legs except the parts mentioned are black; abdomen black, no trace of color; head and thorax bright green; wing veins and stigma black; antennae black except on basal joints beneath. Venezula. . . . . **57. cyaneus,** new species

Last two pairs femora completely rufous, and any dark color on forefemora only slight amount at base 17

17. Abdomen with very strong violaceous, or purplish reflection; and with coxae either partly rufous, or with strong violet reflection; thorax also with strong violet or purple reflection. 18

Abdomen almost black, at the most with hardly noticeable blue or purplish reflection; and coxae all black, and not without strong reflection on thorax, although color may be strong (if some reflection on thorax none on abdomen) 19

18. Forecoxae yellowish at tip, last two pairs yellowish over whole ventral surface; all trochanters yellow; legs all yellow except apical four joints of last pair tarsi are darker; abdomen with greenish reflection; antennae yellow. Peru. . . . . **68. eriodes,** new species

Coxae all black, trochanters black except tips; first two pairs femora, tibiae and metatarsal joints and posterior femora rufous; rest of legs dark; abdomen with strong violet reflection; antennae brown above, yellowish beneath. Paraguay . . . . . **65. puniceus,** new species

19. Strongly yellowish (slightly golden) appressed pubescence over most of head and thorax; antennae brown to blackish above, yellowish beneath; wing veins and stigma yellowish 20

No trace of yellowish pubescence, all silvery; at least all coxae black, except tips (or more of posterior pair) may be yellowish; at least four apical tarsal joints (of posterior pair) may be yellowish; at least four apical tarsal joints of posterior legs black and posterior metatarsal joint darker than the similar joints of first two pairs 21

20. Legs almost wholly yellowish, apex forecoxae, apical half of last two pairs and all rest of legs except apical two or three tarsal joints yellow; antennae brown above, yellow below; thorax bright green; abdomen with dense, slightly yellowish pubescence. Bolivia . . . . **63. aurarius,** new species

Coxae black, yellowish at tip; trochanters yellow, more or less mottled with black; rest of legs yellowish except apical joint of first two pairs and last two joints of last pair are black; antennae black above, yellowish to brown beneath; thorax dull metallic greenish; pubescence not quite so dense and not yellowish on the abdomen; apical edge of tergite and most of apical tergite slightly rufous. Brazil . . . **76. subaurarius,** new species

21. All trochanters yellowish, the apex of all coxae also yellowish; the last four tarsal joints of posterior legs blackish, other parts of legs yellow; abdomen with a trace of blue and violaceous reflection (more so than the other species of this group); antennae brown almost black. Amazon.
59. argentinensis, new species

All trochanters black but tips may be yellowish 22

22. Posterior tibiae black; all femora, and first two pairs tibiae yellow; only the first metatarsal joint rufous; tips of trochanters yellowish; antennae black above, yellowish beneath; thorax deep shining, green, blue, and violet; abdomen black with patches of pubescence in reflected light; wings hyaline, veins and stigma black. Nova Teutonia, Brazil . **62. pratens,** new species

Posterior tibiae yellowish or deep rufous, not black 22

23. Thorax almost black in incident light but strongly dull green in reflected light; antennae black; last two pairs of tarsi completely black; first pair dark rufous; a small species with the thorax and abdomen with pubescence in patches in reflected light; abdomen almost black; some longer hairs which give a rough appearance. Peru . . . . . **64. lasios,** new species

Thorax shining green, blue, or purplish; not black in incident light; antennae brown to yellow below, black above; abdomen with slight colored reflection, not black as in preceding; larger and not as delicate appearing as preceding; all femora and tibiae yellowish or rufous 24

24. All femora, tibiae, and metarsal joints yellowish or rufous; last four tarsal joints become increasingly darker toward tips; head almost black and thorax faint purplish, bluish and greenish in both reflected and incident light; abdomen with slight reflection; antennae only slightly brownish beneath; a patch of white pubescence on outer posterior corners of propodeum; the posterior edge of propodeum with transverse striations; coxae with faint purple reflection. Brazil . . . . . **61. argutus,** new species

Last two metatarsal joints black or almost so; thorax a strong bright shining green; no purple reflection; head with a very faint dark-green reflection; abdomen shining with a faint colored reflection; antennae strongly yellowish beneath; patch of white pubescence at outer posterior corners of propodeum smaller; no striations on posterior surface of propodeum; coxae almost black but with a faint greenish reflection. Brazil.
62. pratens, new species

25. Face and thorax with golden pubescence; clypeus and a triangular spot on lower anterior orbits yellowish; hind border of pronotum also yellowish. Brazil . . . . . **princeps** (Banks)
Face and thorax without golden pubescence; no yellowish color on hind border or pronotum; clypeus not yellow 26
26. All femora black and most of rest of legs 27
Some of femora at least rufous 28
27. Femora and rest of legs black; wings black; head and thorax faintly bluish. Peru . . . . . **peruanus** (Banks)
The front legs beyond femora rufous to yellowish; the midtibiae rufous, tarsi and posterior legs wholly dull black; insect black; lower face and lower parts of pronotum with silvery pubescence; a silvery spot each side behind pronotum and four silvery spots on propodeum; the two spots at hind border the larger; antennae dull yellowish. British Guiana . . . **incrotus** (Banks)
28. Only the hind femora rufous; patches of white pubescence each side at end of propodeum; clypeus and lower face with long white hair. Brazil, Trinidad, British Guiana . . . . . **comparatus** (Smith)
Other femora also rufous 29
29. Antennae pale yellowish, at least on basal part; all femora and tibiae yellowish, trochanters black. Colombia . . . . . **lorenzanus** (Banks)
Antennae nearly black 30
30. Middle and hind tibiae black; body with fine white pubescence, clypeus nearly triangular 33
Middle and hind tibiae yellowish or rufous 31
31. Trochanters yellowish; clypeus and lower face with white appressed pubescence . . . . . **militaris** (Lynch-Arribálzaga)
Trochanters black 32
32. Basal joint of antennae black below as above; propodeum fully as broad at base as long; abdomen broad in middle; antennae deep black; tegulae dark. Brazil . . . . . **rufipes** (Banks)
Basal joint of antennae pale yellowish below; face with white pubescence below and on clypeus; antennae brown to yellowish 34
33. Front femora yellowish as others; wings somewhat yellowish. Colombia. **Ageniella magdalenus** (Banks)
Front femora black, others rufous; wings hyaline. British Guiana. **smithi** (Dalla Torre)
34. Tegulae pale yellowish; propodeum strongly convex, high at base, near turn it is striate or slightly ridged transversely. Colombia, Ecuador. **associatus** (Banks)
Tegulae dark; propodeum low, only slightly convex, not striate. Brazil. **amalotis** (Banks)

MALES

1. Face and clypeus wholly dark or the extreme apical margin of clypeus paler 2
Face or clypeus on sides with a white or yellowish spot or streak, not simply pubescence 5
2. Body plainly bluish and very hairy; all femora and tibiae yellowish, or only the femora and foretibiae yellowish 3
Body black, much less hairy 4
3. All femora and foretibiae yellowish, midtibiae pale, posterior tibiae yellowish brown; foretarsi yellowish except last joint, midtarsi yellowish brown,

posterior pair brown; lower face and clypeus silvery; pronotum, coxae, pleura, and tip of propodeum with fine white pubescence; abdomen black with slight bluish pubescence. British Guiana, Brazil . . **tarsatus** (Smith)

Forelegs with only about apical third of femora rufous, base dark, tibiae rufous, tarsi brown; last two pairs tibiae rufous but dark on base and the knees of last pair dark; last two pairs of tibiae and tarsi black; lower face and clypeus not silvery; the parts mentioned above as having a fine white pubescence do not have it, instead the pubescence is coarse, upright and gives a rough appearance. Venezuela. Fig. 3 . . . . . **57. cyaneus,** new species

4. Clypeus very short, with a median lobe, and sides sloping outward from base of lobe, tibiae dark, no pale spot near tip of abdomen.

smithi (Dalla Torre)

Clypeus without median lobe, truncate below; tibiae partly yellowish, pale spot at tip of abdomen above. Colombia. Figs. 52, 53.

Ageniella magdalenus (Banks)

5. Body black or thorax with just a trace of color, and abdomen may have some brownish but no bright colors 6

Some part of body, mainly thorax, with green or blue colors or violet reflection; in one case rufous on clypeus; abdomen may be all or partly rufous 10

6. Clypeus completely black; face with a yellowish streak on anterior orbits on each side, extending to base of antennae 7

Clypeus white on each side as well as face 8

7. Legs almost completely bright rufous except coxae; foretrochanters yellowish, last two pairs with apical part yellowish; all femora, tibiae, and metatarsal joints yellowish; last four joints of all tarsi black; abdomen not petiolate; abdomen black; third cubital cell extends to apex of marginal cell; a large heavy-bodied insect; length 9.5 mm. Argentina. Figs. 48, 49.

70. coracinus, new species

Legs not completely rufous; foretrochanters a dull yellowish, last two pairs black; middle and last pair femora dark at base and apex; posterior tibiae dark above dark reddish beneath; middle tibiae dark at base and tip; foretarsi rufous, last two pairs wholly dark; abdomen strongly petiolate, the basal segment tinged with rufous; third cubital cell does not extend to apex of marginal cell; a delicate slender-bodied insect; length 7.2 mm; parameres of genitalia narrower than in *coracinus*. Ecuador.

80. editorialis, new species

8. The last two pairs femora black at base; front pair coxae light colored on ventral surface, last two pairs black; front pair trochanters slightly light-colored but black predominating, last two pairs black; all femora and first two pairs tibiae light yellow, last pair tibiae deep rufous, blackish in certain light; first two pairs metatarsal joints yellowish, last pair and last four tarsal joints of all legs dark; white side spots on clypeus covering more than 0.5 of width and the white on sides of face extending to base of antennae; first joint of antennae white beneath, rest yellowish beneath. Brazil. Figs. 46, 47 . . . . . **rufipes** (Banks)

Last two pairs femora wholly yellow; front pair trochanters rufous; all femora and tibiae rufous or reddish yellow; basal antennal joint yellowish white beneath, rest of antennae yellow beneath; thorax black or very faintly with a metallic tinge 9

9. Forecoxae yellowish only at tip; clypeus with a white spot each side, rest black including apex which is slightly upturned and black, hardly a rim; face narrowly white the white color reaching about 0.5 to antennae; para-

mere rather slender for the genus, with long hairs on inside, subgenital plate rather long, ventral ridge not extending to apex. Brazil. Figs. 62, 63.

69. brasiliensis, new species

Forecoxae entirely rufous; clypeus with much more white color about 0.6 of width and apical edge with a white stripe about 0.25 of length, a slight translucent rim; face broadly white the color reaching the antennae, the surface just below antennae black to the preapical white rim of clypeus; parameres very broad and short without hairs; subgenital plate short, the central ridge extending to apex. Brazil. Figs. 72, 73.

77. ater, new species

10. At least one half or more of abdomen testaceous-yellow or rufous . . . 11

No part of abdomen testaceous-yellow, or rufous; basal segment of abdomen may be slightly yellowish in part or basal segment may be ringed with white 13

11. Abdomen, pronotum except central spot above, tegula, ventral surface of thorax, first three antennal joints (rest missing), and legs entirely, testaceous-yellow; face, clypeus, mandibles, and palpi pale yellow; pubescence of body golden and sparse; pronotum angulate behind. Brazil.

testaceous (Fox)

Abdomen may be half rufous, but pronotum on both dorsal and ventral surface is not yellow or rufous 12

12. Basal three segments of abdomen completely rufous; legs completely rufous from coxae on, except apical four tarsal joints are darker; all clypeus, face, and anterior orbits to above antennae, yellow, the yellow extending to antennae; all the thorax with beautiful purplish, violaceous colors; antennae dark yellow. Argentina. Figs. 50, 51.

74. cordobensis, new species

Only the basal abdominal segment more or less yellowish, the second also with a yellowish tinge; all legs completely yellow except last tarsal joints; clypeus yellowish on extreme sides, the middle mostly dull rufous and black; face with yellowish sides reaching about half way to antennae and the yellow not extending above antennae; face in center brownish; antennae yellow on basal joint below, rest brownish black; thorax a beautiful bright green, with purple iridescence. British Guiana. Figs. 64, 65.

75. flavicrus, new species

13. Basal abdominal segment ringed with white; pronotum subangulate behind; head, thorax, and coxae metallic green; clypeus except medially, mandibles, palpi, forecoxae beneath, calcaria, and last tergite whitish; all the femora and anterior tibiae and tarsi yellowish. Brazil. Figs. 58, 59.

basalis (Fox)

Basal abdominal segment not ringed with white; pronotum transverse behind 14

14. All femora but only the front tibiae rufous, or only first two pairs of femora rufous and first two pairs tibiae rufous; body blue or green; antennae yellow beneath 15

All femora and at least first two pairs tibiae yellow; the yellow stripe on anterior orbits extending at least to antennae 16

15. All femora but only the first tibiae rufous; body blue, clypeus broadly yellow each side, the yellow extending on each anterior orbit to middle of face. British Guiana, Brazil, Trinidad. Figs. 42, 43 . . **femoratus** (Fabricius)

Only first pair of femora rufous, the last pair dark with violaceous color, in reflected light; first two pairs tibiae rufous, the last pair dark reddish; foretarsi yellowish, last two pairs dark. Brazil. Fig. 74.

81. viridulus, new species

16. All trochanters rufous, forepair coxae rufous, rest black except middle pair has tip yellow; clypeus white on apical quarter and with a wide transparent rim; white on sides of face does not reach half way to antennae ending in a rounded point just opposite antennae; all femora and tibiae yellowish and all tarsal joints deep rufous; antennae yellow; basal two segments of abdomen suffused with yellowish. Paraguay, Brazil. Figs. 44, 45 . . . . . **65. puniceus,** new species

Trochanters black, except first pair may be yellowish; clypeus white across apical 0.25 or less and if clypeus has a broad transparent rim the white of face almost touches antennae 17

17. Thorax a very dark green on sides except mesonotum which is bright green; clypeus with a broad transparent rim; face and clypeus almost entirely white, the face just below antennae darkish, the blotch extending to apical 0.3 of clypeus as a brown cloud; antennae bright yellow beneath, dull yellow above; forecoxae beneath and foretrochanters rufous; posterior tibiae darker than the others; last two pairs tarsi deep rufous. Surinam. Figs. 56, 57 . . . . . **72. Stagei,** new species

Thorax a brighter green on sides, mesonotum may be a dull green; a well-defined black stripe below antennae to the preapical white rim of clypeus; forecoxae black or green 18

18. Antennae deep yellow; forecoxae strongly green the last two pairs with less green color; foretrochanters yellow, last two pairs dark; ventral part of thorax deep-green; face, clypeus and sides of thorax strongly, appressed, silvery pubescent; last two pairs tarsal joints only slightly darker than the rest of legs. British Guiana. Figs. 54, 55 . . **71. schausi,** new species

Antennae dull yellow below, black above; all coxae black, not green; ventral part of thorax black like coxae 19

19. Foretrochanters mostly black suffused with yellow; last pair tibiae and tarsi darker than the rest; clypeus slightly sericeous, but no silvery pubescence on thorax; pronotum and sides of thorax green or bluish; mesonotum dark like ventral part of thorax; a few long hairs on sides of volsellae. Brazil. Figs. 66, 67 . . . . . **73. malinus,** new species

Foretrochanters mostly black; last pair tibiae rufous, last pair tarsi dark, sides of thorax dull green, sides of pronotum bluish; mesonotum a strong dull metallic green; hairs on sides of volsellae very short hardly noticeable. Brazil. Figs. 70, 71 . . . . . **78. pratentis,** new species

57. *Auplopus cyaneus,* new species

FIGURE 3

Holotype male. Head and thorax green, in certain light bluish with a tinge of violet; abdomen black, in reflected light just a trace of bluish; head and thorax very hairy, with both upright and prostrate white hairs, abdomen much less hairy and with light, very fine white pubsecence on both dorsal and central surface; coxae and femora with some long hairs; forefemora rufous on front and on apical 0.25 on posterior side; middle and posterior femora rufous but black on basal 0.25 of second pair and black on basal 0.2 and knees of last pair; foretibiae rufous, last two pairs black; all tarsi black; clypeus with hardly a rim, almost truncate in front and with a bulge in center; clypeus 2.7 as wide as long; antennae exceedingly slender; first seven

joints cylindrical but slightly bulging in center on ventral side on last six joints; ratio of length of first four joints is 40:12:50:50; interocular distance at vertex and clypeus almost equal; the interocular distance at greatest width is 0.64 the transfacial distance; the head not quite 1.2 as wide as long; the lateral ocelli as far from each other as from eyes; the front, mesoscutum, scutellum strongly punctured, the postscutellum strongly striate on sides; the propodeum slightly striated on posterior surface; wings hyaline, veins black.

Length head and thorax 4.6 mm., abdomen 4.0 mm., forewing 7.6 mm., rear wing 5.3 mm.; length genitalia 0.90 mm., width 0.64 mm.; subgenital plate lost.

Holotype male: Caracas D. F., Venezuela, Aug. 22, 1930, H. Pittier 1578 (USNM).

Allotype female. Color of body and legs as in the male; the hairs on body about the same; punctation not quite as strong; pygidium smooth and shining; clypeus extended in front in middle with a hairless rim not quite 2.0 as wide as long; head 2.0 as wide as long; interocular distance 0.55 the transfacial distance; ratio of length of first four antennal joints 50:16:80:60; upper and lower interocular distances 1.1.

Length head and thorax 4.9 mm., abdomen 4.9 mm., forewing 8.6 mm., rear wing 6.3 mm.

Allotype female: Rio de Janeiro, Brazil, January 1939, Yel. Fever Serv. MES, R. C. Shannon (USNM).

58. *Auplopus ferrugineus*, new species

Holotype female. Whole body and legs a reddish color, except a spot over ocellar region, two spots each side of base of pronotum, all the mesonotum, the sides and posterior edges of scutellum and postscutellum, and the dorsal surface of propodeum are black; clypeus rounded in front, 1.7 as wide as long; head slightly wider than long; interocular distance 0.6 the transfacial distance; the lower interocular distance 1.5 the upper, thus the eyes converging at the vertex; ratio of length of first four antennal joints is 60:20:95:70; the second and third antennal joints equal to vertex width; pronotum very slightly angular on posterior edge; the anterior edge of wing very strongly brownish the color extending backward through median cell and the three cubital cells to the tip of wing, strongly contrasting with the hyaline rear half of wing; basal and transverse median veins in forewings and the cubitus and subdiscoidal veins in rear wings much disjointed; the front of clypeus, coxae, and apex of abdomen with some fairly long hairs; the propodeum long-haired, the head and thorax with copious prostrate pubescence which appears golden

against the reddish yellow background; a very large species for the genus.

Length of head and thorax 6.0 mm., abdomen 6.6 mm., forewing 6.6 mm., rear wing 9.6 mm.

Holotype female: Amazon, H. W. Bates (Munich Mus.).

Paratypes: 1, Amazonas, Santarém, Brazil, W. Bates (USNM); 1, Amazon, W. Bates (RRD).

The paratypes vary somewhat in the amount of dark color. One (USNM) has the whole front and vertex a dull green and the color on thorax has a greenish tinge. The other paratype (RRD) has a greenish tinge on head, and more surface colored than the type but not so much on thorax, that on propodeum only as a light purple streak, the coloration of wings and the other characters are the same.

59. *Auplopus argentinensis*, new species

Holotype female. Head opaque black with the faintest greenish tint on the front; thorax green or violet depending on the incident light; abdomen shining through a fine prostrate pubescence, with a bluish violet sheen (very delicate); all coxae black, apex underneath yellowish; all trochanters, femora, and tibiae yellowish; the tarsi with first joint yellowish the rest of joints becoming darker as they approach tip; clypeus and face heavily silvery sericeous, the thorax not quite so much so; clypeus projecting in front as usual, and with a polished rim on the extension; the front rim of clypeus slightly yellowish; clypeus 1.7 as wide as long; upper interocular distance (90) 0.9 as long as the lower; head 1.2 as broad as wide; interocular distance 0.55 the transfacial; lateral ocelli 1.5 as far from eyes as from each other; ratio of length of first four antennal joints is 40:20:90:70; third antennal joint is equal to the vertex width; pronotum slightly angulate on posterior border; the dorsal surface of propodeum finely transversely ridged as well as the metapostnotum; wings hyaline (slightly yellowish), veins yellow.

Length head and thorax 5.3 mm., abdomen 4.3 mm., forewings 9.2 mm., rear wings 6.6 mm.

Holotype female: Amazonas, W. Bates (Munich Mus.).

60. *Auplopus batesi*, new species

Holotype female. Clypeus and face black; front, vertex and thorax, and dorsal surface of coxae from dull green to a rather brilliant green; abdomen black with a bluish-green luster shining through the fine, whitish vestiture; antennae wholly dark yellow; all the legs black except the apices of the foretrochanters, the apical 0.75 of forefemora, and the foretibiae; the face and clypeus strongly silvery pubescent, as is the whole body; mouth parts, and mandibles except base, yellowish; clypeus rounded in front, almost twice as wide as

long; lower and upper interocular distance equal; the interocular distance 0.55 the transfacial distance; head 1.25 as broad as long; ratio of length of first four antennal joints is 40:20:70:60; lateral ocelli about 1.2 as far from eyes as each other; pronotum transverse on posterior margin; propodeum with very fine transverse wrinkles; wings hyaline; pygidium polished and shining.

Length head and thorax 5.3 mm., length abdomen 5.0 mm., length forewing 8.0 mm., rear wing 5.9 mm.

Holotype female: Amazonas, W. Bates (Munich Mus.).

61. *Auplopus argutus*, new species

Holotype female. Clypeus, face, and head black; thorax with rather brilliant violet or purplish sheen in reflected light with traces of green and blue; abdomen almost black with hardly a trace of reflected color; coxae and trochanters black with the apices of trochanters slightly yellowish; all femora, tibiae, and metatarsal joints bright shining (hence name) yellowish, except that last two pairs of tarsi are blackish on apex; the forefemora are black just at base; antennae black, lighter underneath; a few long whitish hairs scattered over body, the propodeum with numerous long upright hairs; the face and outer posterior corners of propodeum with dense, silvery, shining pubescence; labial palpi yellowish; mandibles black with reddish tips; clypeus rounded on front margin with a narrow hairless rim, the width 2.0 times its length; head 1.15 times as wide as long; interocular distance is 0.54 times the transfacial; upper interocular distance (90) equal to the lower; ratio of lengths of first four antennal joints is 40:15:75:60, thus the second and third joints are equal to the vertex width; lateral ocelli about 1.5 as far from eyes as from each other; pronotum transverse on posterior edge; head and dorsum of thorax finely, densely punctured; propodeum with very fine transverse ridges; wings hyaline, venation about as usual, except the second intercubital meets third cubital cell a little farther out than usual, about the apical 0.3; pygidium smooth and shining.

Length head and thorax 6.0 mm., abdomen 4.7 mm., forewing 8.6 mm., rear wing 6.6 mm.

Holotype female: Nova Teutonia, Santa Catarina, Brazil, Feb. 1, 1956, Fritz Plaumann (USNM).

Paratypes: 1, Olivos, Prov. Buenos Aires, Argentina, March 1951, M. A. Fritz (RRD); 1, Corupá, Santa Catarina (Harrsa Humbolt), Brazil, October 1946, A. Maller (AMNH); 6, Nova Teutonia, Brazil, Fritz Plaumann; Mar. 2 and 3, 1950, Apr. 27, 1950 (RRD), Mar. 4 and 23, 1951, Mar. 29, 1951, Mar. 24, 1950, Apr. 23, 1951 (Cal.).

62. *Auplopus pratens*, new species

Holotype female: Mandibles (except tips, reddish), clypeus, and face black; front and vertex dull green with very fine, dense punctures; thorax a brilliant shining green with punctures on mesonotum larger than on head; abdomen black, shining in reflected light, and a slight tinge of color, pygidium smooth and shining; all femora, first two pairs of tibiae between rufous and black; last four joints of foretarsi and all joints of last two pairs, black; coxae and trochanters black, with the latter yellowish at tip; antennae black above, dull yellowish beneath; clypeus, face, and the outer posterior corners of propodeum rather densely, silvery pubescent; few long hairs on body except at apex of clypeus, under head and more strongly on propodeum, and a few scattered ones on ventral segments; clypeus almost truncate in front, 2.0 times as wide as long; upper interocular distance (90) about 0.9 of the lower; head 1.3 times as long as wide; middle interocular distance 0.60 the transfacial distance; ratio of lengths of first four antennal joints is 45:20:70:55, thus the second and third antennal joints equal the vertex width; wings hyaline, the second intercubital vein meets third cubital cell at basal 0.36; pronotum very slightly angular on posterior border and the propodeum has fine, transverse striae on dorsal surface.

Length head and thorax 5.3 mm., abdomen 5.0 mm., forewing 9.3 mm., rear wing 6.6 mm.

Holotype female: Nova Teutonia, Santa Catarina, Brazil, Feb. 23, 1956, Fritz Plaumann (Townes).

Paratypes: 2, Apr. 4, 1951, Mar. 7, 1951 (Cal.); 2, Apr. 7, 1951 (RRD) (USNM).

63. *Auplopus aurarius*, new species

Holotype female. Basal half of mandibles and clypeus (except extreme apical tip reflects reddish) black, apical half mandibles reddish; rest of head a dull faint greenish; pronotum, sides of thorax and all of propodeum bright greenish; the mesonotum black, scutellum and postscutellum dull greenish about like head; abdomen black, shining in reflected light, through the very fine, dense, yellowish pubescence; pygidium smooth shining; the clypeus, face, sides of pronotum, the shoulders of pronotum, the sides of thorax, the propodeum across the apex, the apical sides of thorax, and ventral surface of forecoxae, covered with a more or less dense, golden tinted, prostrate pubescence; this pubescence gives a beautiful yellowish (almost golden) glistening appearance to the whole body in reflected light; all the legs starting with trochanters a bright shining reddish yellow, except the last two joints of the first two pairs of legs are black (the tarsal joint of last pair

legs lost); the forecoxae black, the last two pairs black (greenish tinted) on about basal third, the rest yellowish; antennae dark brown dorsally, yellowish ventrally; long hair on front edge of clypeus, mandibles under head and on dorsal surface of propodeum; pencil of hairs on mentum exceptionally noticeable, long and rather thick, reddish; clypeus convex in front; with a fairly wide hairless rim in front, 2.0 times as wide as long; head a little over 1.1 as broad as long; interocular distance 0.53 times the transfacial; the eyes converging below, the upper interocular distance (100) 1.25 times the lower; the ratio of lengths of first four antennal joints is 40:15:70:55, thus the second and third antennal joints (85) not equal to the vertex width (100); the lateral ocelli a little more than 2.0 times as far from eyes as each other; pronotum very short, transverse across posterior edge; front and mesonotum very finely punctured; the propodeum finely striated; wings hyaline, slightly yellowish, the veins and stigma bright yellow.

Length head and thorax 4.7 mm., abdomen 5.3 mm., forewing 9.2 mm., rear wing 6.6 mm.

Holotype female: Yungas, Bolivia, Forestal 2500M, June 6, 1950, W. Forster (Munich Mus.).

64. *Auplopus lasios*, new species

Holotype Female. Ground color black; clypeus and face black, front and vertex with a dull-green tinge; pronotum and propodeum a greenish tint, the rest of thorax almost black; abdomen shining black with just a hint of bluish iridescence, hardly noticeable; coxae and trochanters black; all femora and all tibiae yellowish; all tarsi and spurs black; hairy and woolly in appearance; numerous upright hairs on front of clypeus, mouth parts under head, on front, on coxae, sides of thorax, propodeum (strongly on posterior half), and on sternum of abdomen; densely silvery, pubescent (with a yellowish tinge) on clypeus and face, and outer posterior corners of propodeum; thorax with the pubescence less dense; abdomen with a silvery bloom, in reflected light showing up as a patch on each side of third and fourth tergite; front, vertex and mesonotum finely, densely punctured; scutellum and postcutellum with much larger more widely separated punctures; pygidium smooth and shining; base of mandibles black, apical half reddish; clypeus rounded in front with a hairless shining rim across front, reddish on rim; clypeus 2.0 as wide as long; head not quite 1.2 as wide as long; interocular distance (70) slightly greater than the lower (65); the joints of antennae becoming increasingly thicker from third to seventh; the lateral ocelli 2.0 as far from each other as from eyes; ratio of length of first four antennal joints is 30:15:50:40, thus second and third joints not quite as long as vertex

width; pronotum transverse on posterior edge; wings almost hyaline but definitely brownish.

Length head and thorax 4.0 mm., abdomen 4.0 mm., forewings 6.7 mm., rear wings 4.7 mm.

Holotype female: Monson Valley, Tingo María, Peru, Nov. 16, 1954, E. I. Schlinger and E. S. Ross (Cal. Acad. Sci.).

65. *Auplopus puniceus*, new species

FIGURES 44, 45

Holotype female. Clypeus and face black, front and vertex dull bluish with violet to purple reflection; thorax greenish from mesonotum to propodeum, pronotum, propodeum and sides of thorax with some greenish but with brilliant purplish to violet iridescence; abdomen shining bluish, violet and purple, pruinose in reflected light; clypeus, face, sides of pronotum, parts of sides of thorax and outer posterior corners of propodeum silvery pubescent (rather coarse and not very dense); antennae a brownish black; coxae various shades of bluish and purple in reflected light; trochanters black; all femora yellowish; foretibiae yellowish, last two pairs blackish with a purple tinge; forebasitarsi yellow in certain light, blackish in other light, last two pairs black, spurs yellowish; mandibles with basal half black, apical half reddish, mouth parts yellowish; clypeus rounded in front with a hairless shining rim, which is slightly reddish; clypeus 2.0 times as wide as long, head a little more than 1.1 times as long as wide; interocular distance in middle 0.51 times the transfacial; upper interocular distance (85) not quite the lower interocular (90); ratio of length of first four antennal joints is 40:20:75:65, thus second and third antennal joint is equal to the upper interocular distance; the lateral ocelli as far from each other as from eyes; pronotum transverse on posterior border, just an indication of an angle; head finely, minutely punctured, the mesonotum with slightly larger punctures; wings hyaline, veins and stigma yellow; pygidium smooth and shining, the last segment of abdomen rather strongly hairy on sides and beneath.

Length head and thorax 5.0 mm., abdomen 5.0 mm., forewing 8.6 mm., rear wing 6.6 mm.

Holotype female: San Bernardino, Paraguay, Nov. 6 (USNM).

Paratypes: 2, San Bernardino, Nov. 12, 1927, K. Fiebrig (USNM); 1, Amazonas, Santarém, W. Bates (Munich Mus.), same data as above paratype (RRD).

Allotype male. Clypeus white except a large white spot in middle; face broadly white on inner orbits to opposite to base of antennae, center white with a black streak on each side on inside of white of inner orbits, front and vertex with faint greenish tint with faint

violet reflection; dorsum of thorax to propodeum a more or less dull greenish; posterior edge of pronotum violet to purple, the sides with violet reflection; sides of thorax and propodeum with a brighter green color with violet to purple reflection; color of abdomen similar to female, except apex of first and second tergites is yellowish and posterior edge of fifth and sixth tergites a broader area yellowish white and all of the seventh tergite; the ventral surface of first and second sternites yellowish; forecoxae yellowish with some violet reflection; last two pairs coxae black with bluish reflection and apex slightly yellowish; first pair trochanters yellow, middle pair dark yellow and last pair almost black; first two pairs femora and tibiae yellow, last pair femora yellow (slightly dark at base) and last pair tibiae very dark reddish; almost all foretarsi yellow, basal joint of second a darker yellow, the last four joints of second pair and all joints of last pair dark; mandibles (except a very small black spot at base) and all mouth parts yellow; antennae dark yellow last few joints blacker; clypeus and face densely covered with prostrate silvery pubescence; sides of thorax also clothed with dense pubescence; clypeus truncate in front with a wide hairless rim, 3.2 as wide as long; middle interocular distance 0.65 of transfacial; head 1.2 as wide as long; upper interocular distance (80) slightly greater than the lower (75); ratio of length of first four antennal joints is 40:20:55:55; wings hyaline slightly yellowish, veins and stigma yellowish; subgenital plate with a high ridge which extends to tip of plate, the basal triangle closed about middle of visible part (not dissected); sixth ventrite with a deep V-shaped notch.

Length head and thorax 4.6 mm., abdomen 4.6 mm., forewing 8.6 mm., rear wing 6.0 mm.; length genitalia 0.86 mm., width 0.46 mm., length subgenital plate 0.93 mm., width 0.40 mm.

Allotype male: San Bernardino, Paraguay, Nov. 15, 1927, K. Fiebrig (USNM).

Paratype male: Same data as allotype except no date (RRD).

66. *Auplopus alarius*, new species

Holotype female. Clypeus black, rest of head dull greenish; thorax a brighter green especially in certain spots; abdomen shining greenish in reflection through the rather dense bloom; all femora black with greenish reflection (color more brown than black); tibiae a lighter brown with green reflection; apices of tibiae as well as of femora yellowish, foretibiae almost yellow beneath; tarsi all dark yellowish; coxae and trochanters greenish; mandibles black at base reddish at apex; labial palpi light yellow; antennae yellow, lighter beneath; clypeus truncate in front 1.7 times as long; interocular distance broad; head 1.35 as broad as wing, interocular distance at middle 0.5 times the transfacial distance; the upper interocular in distance

(75) only 0.9 the lower (85); lateral ocelli 20 times as far from eyes as each other; ratio of length of first four antennal joints is 40:15:90:70, thus the third antennal joint longer than vertex width; pronotum transverse on posterior border, propodeum with fine transverse striae on posterior 0.75; the posterior 0.25 of propodeum is covered with dense white pubescence; the anterior edge of wing from front of first cubital cell through the second, and third cubital cell and the marginal cell strongly yellowish, contrasting strongly with the rest of the hyaline wing (hence the name); the dorsal surface of the propodeum and apex of abdomen very strongly long-haired.

Length of head and thorax 5.0 mm., abdomen 4.6 mm., forewing 7.9 mm., rear wing 5.9 mm.

Holotype female: Amazonas, W. Bates (Munich Mus.).

67. *Auplopus striatus*, new species

Holotype female. The whole body brilliantly colored with various shades of blue, greenish violet, and purple, the latter on the propodeum, the coxae bluish and purple, the femora and tibiae mostly with purple sheen; tarsi black, no reflection; mandibles black, reddish on apex; clypeus black on apical half or more, purple tints on basal half or less; antennae black, brown underneath; scattered long hair over body, propodeum with considerable long hair on apical dorsal surface; pygidium smooth and shining, clypeus with a bare black edge at apex, not projecting so much in middle as usual; clypeus 2.0 as wide as long; head not quite 1.1 times as wide as long; upper interocular distance (85) equal to the lower; interocular distance in middle 0.58 the transfacial distance; the ratio of length of the first four antennal joints is 40:15:75:60, thus the second and third antennal joints just about equal to the vertex width; the basal joint of antennae bluish tint; lateral ocelli 3.0 times as far from eyes as each other; front and mesonotum with very small, dense punctures, those on scutellum and postscutellum larger and farther apart; propodeum behind the spiracle with transverse (rather large) ridges on the sides which extend across dorsal surface; smaller ridges in front of posterior margin of spiracle; pygidium smooth and shining; wings dark brown over whole surface.

Length of head and thorax 4.6 mm., abdomen 4.0 mm., forewing 8.3 mm., rear wing 5.9 mm.

Holotype female: Verrugas Canyon, Lima, Peru, Mar. 15, 1928, R. C. Shannon, P–1 (USNM).

Paratypes female: 1, same date as holotype except date is May 18, 1928 (RRD); 1, Lima, Peru, received from Luis Pro Castillo with letter Feb. 11, 1930, P-1 (USNM); 1, Lima, Peru, Dec. 21, 1912, C. H. T. Townsend (USNM).

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Very similar to *A. bellus* (cr) except in the latter the lower interocular distance at vertex is less than the upper, the lateral ocelli are 2.0 as far from eyes as each other, the striae on propodeum are much weaker and color is different; the last paratype is smaller than the other two specimens, the striae on propodeum not so strong, and the color is slightly different. It may be a different species.

68. *Auplopus eriodes*, new species

Holotype female: Clypeus bluish black with the apical half slightly fuscous; head dull green, with the scutellum and postscutellum a bright shining green; pronotum a bluish green, mesonotum a duller bluish green, the propodeum a dull bluish green; sides of thorax about like the pronotum; abdomen with a bluish to violet shining color reflecting through the rather copious dense bloom; the very fine, dense, whitish pubescence causing the bloom forming broad spots on the sides of tergites from the second through the fifth; antennae dull yellowish; forecoxae bluish with apex underneath yellowish, the last two pairs bluish violet with the ventral surface a dull yellow; trochanters, femora, and tibiae of all legs light yellowish; the tibiae of forelegs yellow, the last two pairs yellow with the last three joints slightly darkened; the clypeus face, pronotum, sides of thorax, and all propodeum except a small space in center densly white pubescent; considerable longer hair scattered over the body, giving the body a woolly appearance (hence the name); clypeus rounded in front 2.2 as wide as long; head 1.25 times as wide as long; middle interocular distance 0.6 the transfacial distance; the upper interocular distance (85) very slightly larger than the lower (80); the ratio of length of first four antennal joints is 35:15:60:50, thus the second plus third antennal joint not quite equal to the width at vertex; lateral ocelli 2.0 as far from eyes as from each other; the head and dorsum of thorax very finely and densely punctured, the punctures becoming stronger beyond the mesonotum; the propodeum with a few fine striae on central hairless dorsal surface, any on haired portion hidden by the pubescence; pronotum transverse behind; pygidium smooth and shining; wings hyaline with a yellowish tint.

Length head and thorax 4.33 mm., abdomen 3.3 mm., forewing 7.6 mm., rear wing 5.9 mm.

Holotype female: Dept. Piura, Peru, Jan. 30, 1911, C. H. T. Townsend (USNM).

69. *Auplopus brasiliensis*, new species

FIGURES 62, 63

Holotype male. A white spot on outer edge of clypeus which continues on sides of face and inner orbits to a little above antennae; the

spot does not reach front margin of clypeus, the spots on each side cover about 0.3 of clypeus, and at junction of face and clypeus a white line extends toward center a short distance on face; the rest of head and thorax is black, no trace of color except the propodeum has a very faint greenish reflection; abdomen black with faint blue reflection, the first tergite dark yellowish or brownish on sides and ventral surface, and the seventh tergite with a white spot; coxae all black, extreme apex slightly yellowish; trochanters black with more of their apex yellowish; all femora, tibiae, and basal tarsal joints yellowish, the last two tarsal joints of foretarsi and last four joints of last two pairs, dark; clypeus truncate in front (very slightly concave) with a narrow rim in front which is black on middle third, 2.4 times as broad as long; head 1.25 times as wide as long; middle interocular distance 0.52 times the transfacial; upper interocular distance (80) equal to the lower; the ratio of lengths of first four antennal joints is 40:13:55:55; lateral ocelli 2.0 times as far from eyes as from each other; face, clypeus, ventral surface of coxae, sides of thorax, and about posterior third of propodeum (actually most of propodeum in certain reflected light) silvery sericeous; basal half of mandibles black apical half yellow, as are all the mouth parts; wings hyaline but slightly brownish, veins and stigma rather dark.

Length head and thorax 5.0 mm., abdomen 4.3 mm., length forewing 7.9 mm., rear wing 5.3 mm.; length genitalia 0.94 mm., width 0.53 mm., length subgenital plate 1.00 mm., width 0.43 mm.

Holotype male: Campinas, São Paulo, Brazil, Sept. 15, 1939, H. F. G. Sauer (USNM).

70. *Auplopus coracinus*, new species

FIGURES 48, 49

Holotype male. Body completely black, except for a narrow white stripe on anterior orbits from apex of face to opposite base of antennae; face and clypeus with fine white, prostrate pubescence, but the pubescence hardly giving a silvery appearance; front slightly shining with a mat appearance; thorax with very fine pubescence, which in certain light gives the appearance of a bloom, mat; all coxae black, trochanters yellow with a dark cast; all femora and tibiae yellow; all basal tarsal joints yellow; last tarsal joint of forelegs, last two tarsal joints of middle legs, and last four tarsal joints of last legs blackish, rest of joints yellow; wings hyaline, slightly dusky, veins and stigma brown; clypeus almost truncate in front, a very narrow hairless rim which is black across the whole front, 2.2 times as wide as long; interocular distance at middle 0.6 the transfacial; head 1.1 times as broad as long; upper interocular distance (90) slightly greater than the lower (85); ratio of lengths of first four antennal joints is 45:15:55:55; lateral ocelli 2.0

times as far from eyes as each other; subgenital plate with a high short median ridge its whole visible length; apex of plate triangular with scattered long, partly upright, backwardly directed black hairs; the high ridge as high as width of side piece each side of it; the sixth ventrite with a broad flat central part almost truncate at apex with a rather deep, broad groove (as broad as central part of plate just before apex) each side, the apical outer tip of this groove bears the small tooth or hooklet; the central part extends beyond groove by about 0.5 the width of latter.

Length of head and thorax 5.3 mm., abdomen 4.3 mm., length of forewing 8.3 mm., rear wing 5.7 mm.; length genitalia 0.93 mm., width 0.55 mm., length of subgenital plate 1.13 mm., width 0.47 mm.

Holotype Male: Neuquén, Catán-Lil, Argentina, 1954, F. H. Walz (USNM).

71. *Auplopus schausi*, new species

FIGURES 54, 55

Holotype male. Clypeus yellowish white except for about 0.3 of width in middle is dull greenish, the apex white across, the apical 0.25, with a narrow hairless rim; broad inner orbits whitish to above base of antennae; rest of head and thorax a rather bright green, with violet and purple reflection; abdomen black with bluish and violet reflection; clypeus and face with strong silvery pubescence that hides the yellowish color in certain light; thorax with prostrate, rather dense silvery pubescence over most of surface; abdomen with bloom that shows up in certain light as broad patches of pubescence on the sides of tergites; sides of first and second tergites slightly yellowish; the last tergite white; mandibles black on basal half, yellow on apical half and all mouth parts yellow; all coxae greenish on sides, black on ventral surface, yellowish on apex; the foretrochanters yellow, middle pair black with yellow apex, last pair black with bluish reflection and yellow apex; all femora and tibiae yellow; all tarsal joints of forelegs yellow except the apical one, the last two pairs tarsi black; antennae brown on top, yellow below; clypeus 2.0 as wide as long; middle interocular distance 0.56 the transfacial; head 1.25 times as broad as long; upper interocular distance (80) is greater than the lower (70); the ratio of length of first four antennal joints is 40:12:65:60; lateral ocelli 1.2 as far from eyes as from each other; wings hyaline; subgenital plate with a high ridge as high as width of side plate; sixth ventrite without grooves as in *A. coracinus*.

Length head and thorax 5.0 mm., abdomen 3.3 mm., forewings 7.6 mm., rear wings 5.1 mm.; length genitalia 0.80 mm., width 0.40 mm., length subgenital plate 0.80 mm., width 0.40 mm.

Holotype male: Maroni River, Dutch Guiana, Wm. Schaus (USNM).

72. *Auplopus stagei*, new species

FIGURES 56, 57

Holotype male. Clypeus white (in reflected light, color cannot be seen with incident light), with a greenish spot at basal middle; head and thorax deep green; abdomen blackish on tergites 1–5, with bluish reflection; tergites one and two yellowish at apex, tergite seven white; ventral segments somewhat brownish; clypeus and face densely covered with prostrate, silvery, rather coarse pubsecense so that the color cannot be seen except in reflected light; thorax with copious, coarse, silvery pubescence; forecoxae yellow, greenish on sides, middle coxae brown, on ventral surface, green on sides, last pair greenish brown; foretrochanters yellow, last two pairs blackish; all femora yellow; foretibiae yellow, middle tibiae dark yellowish with violaceous reflection, last pair reddish yellow with violaceous reflection; last three joints of foretarsi dark as are all the joints of last two pairs; antennae brown above, yellow below; base of clypeus dark, apex yellow as well as all mouth parts; clypeus with a very broad transparent rim, 2.0 times as broad as long, it does not extend under eyes; interocular distance at middle is 0.61 the transfacial distance; the head is 1.1 as wide as long; upper interocular distance (60) equal to the lower; the ratio of first four antennal joints is 35:10:45:45; the lateral ocelli 1.5 as far from eyes as each other; wings hyaline, veins and stigma yellowish; a high narrow ridge on subgenital plate, plate almost acute at apex.

Length of head and thorax 3.3 mm., abdomen 3.3 mm., length forewing 5.6 mm., rear wing 4.0 mm.; length genitalia 0.73 mm., width 0.34 mm., length subgenital plate 0.73 mm., width 0.33 mm.

Holotype male: Moengo, Suriname, Ibapr, 1946, H. H. Stage, light trap (USNM).

73. *Auplopus malinus*, new species

FIGURES 66, 67

Holotype male. Outer half of clypeus white, and white across apical edge; a black spot in middle extending up to base of antennae, the black on face as wide as distance between bases of antennae, the black spot a little wider on clypeus; inner orbits with a triangular white spot extending to base of antennae; front and vertex, plates just above middle and posterior coxae, mesonotum, and abdomen black; the rest of sides of thorax and rest of dorsal surface of thorax, greenish (the pronotum is more bluish); abdomen has the last tergite white; coxae and trochanters black, the latter with apex yellowish;

all the femora and first two pairs tibiae bright yellowish (the posterior femora darker); last pair tibiae dark, deep reddish in reflected light; forebasitarsi yellow, last four joints and all joints of last two pairs dark; antennae black above, yellow beneath; clypeus truncate in front with a very narrow hairless apical edge; clypeus, and outer posterior corners of propodeum silvery; considerable long brown hair on thorax; clypeus 2.0 times as broad as long; middle interocular distance 0.57 times the transfacial; upper interocular distance (60) slightly longer than the lower (55); ratio of lengths of first four antennal joints is 30:12:40:40; lateral ocelli about 1.5 times as far from eyes as from each other; wings hyaline, slightly yellowish, veins and stigma yellowish; spurs of legs brownish; the basal triangle on subgenital plate open to the apical 0.2; the transverse ridge on parameres with its inner edge located about the middle of apical outer edge of volsellae, sloping toward base.

Length head and thorax 3.6 mm., abdomen 3.3 mm., length forewings 6.0 mm., rear wings 4.3 mm.; length genitalia 0.66 mm., width 0.40 mm., length subgenital plate 0.73 mm., width 0.60 mm.

Holotype male: Nova Teutonia, Santa Catarina, Brazil, Feb. 16, 1956, Fritz Plaumann (Townes).

Paratypes: Following four paratypes from same locality as holotype: 1, Mar. 3, 1955 (RRD); 1, Feb. 13, 1956 (Townes); 1, Jan. 28, 1956 (RRD); 1, Nov. 28, 1956 (Townes); also, 1, Nova Teutonia, Brazil, Apr. 9, 1952, Fritz Plaumann (Cal.).

74. *Auplopus cordobensis*, new species

FIGURES 50, 51

Holotype male. Front, vertex, and thorax with ground color black, thorax with beautiful violet to purple reflection; clypeus and face completely white, the anterior orbits white about half way from base of antennae to foreocellus, the white stripe pointed at apex, triangular-shaped with the base of triangle white from eyes to base of antennae; mouth parts and mandibles of same color (yellowish white) except extreme base of mandibles are reddish; antennae yellow below, brown above; first two segments of abdomen completely yellowish and most of third but mottled with black; the apex of the remainder of tergites yellowish on apical edge; legs completely yellowish beginning with the coxae, except the last two pairs of tarsi are darker, reddish; face and clypeus silvery sericeous and most of thorax slightly sericeous; propodeum with much upright white hair, but little upright hair on rest of body; clypeus truncate in front with a wide transparent, hairless margin, 2.0 times as broad as long; head 1.3 as broad as long; upper interocular distance (70) is equal to the lower; middle interocular distance is 0.66 the transfacial distance; ratio of

length of first four antennal joints (rest lost) is 30:15:43:40; the lateral ocelli only slightly farther from eyes than from each other; wings hyaline.

Length of head and thorax 3.4 mm., abdomen 3.3 mm., forewings 6.6 mm., rear wings 4.6 mm.; length genitalia 0.73 mm., width 0.46 mm., length subgenital plate 0.86 mm., width 0.46 mm.

Holotype male: Capilla del Monte, Cordoba, Argentina, Prof. Hoseus (Munich Mus.).

75. *Auplopus flavicrus*, new species

FIGURES 64, 65

Holotype male. Front, vertex, and thorax greenish, the thorax with brilliant purple shades; basal segment of abdomen yellowish with some black color on apical dorsal half; rest of abdomen blackish (with bluish reflection) except for a yellowish streak on middle of sides of segments 3 to 5; mouth parts and mandibles yellow; clypeus yellowish on sides and apex with basal, middle part blackish; anterior orbits to the antennae broadly yellow, face blackish; under side of head black; antennae with the first two joints yellowish the rest black; the legs beginning with coxae completely bright yellow except for last two joints of front pair and all the tarsal joints of last two pairs, which are dark; clypeus 1.7 as wide as long, the sides of clypeus converging in front so that apical width only 0.7 the basal width; a narrow transparent rim on sides and apex of clypeus; head 1.2 as wide as long; middle interocular distance 0.53 the transfacial distance; upper interocular distance (70) is equal to the lower; lateral ocelli 1.3 as far from eyes as each other; ratio of lengths of first four joints of antennae is 40:15:55:50; silvery pubescence on clypeus, face, sides of thorax and across apex of propodeum; long white hair under head and on dorsal surface of propodeum; wings hyaline, venation as usual; parameres of genitalia extemely slender for the genus, especially in apical half; cross-ridge on parameres about opposite apex of aedeagus; parapenial lobes rather broad; genitalia distinctive; subgenital plate with basal triangle narrow, closed above middle of plate.

Length of head and thorax 4.6 mm., abdomen 4.5 mm., forewing 8.6 mm., rear wing 5.5 mm.; length genitalia 0.56 mm., width 0.60 mm., length subgenital plate 0.66 mm. (without stem), width 0.33 mm.

Holotype male. Kartabo, Bartica District, British Guiana, July–August 1920 (MCZ).

76. *Auplopus subaurarius*, new species

Holotype female. Body blackish with faint shades of colors; head black with faint greenish tinge on vertex in certain light; thorax more strongly greenish and bluish even in incident light; abdomen slightly

violaceous; mouth parts yellow, middle half of apex of clypeus and apex of mandibles reddish; coaxae black with their apices yellowish; trochanters rufous, suffused with black, especially the last pair; femora rufous with a blackish (slightly purplish) stripe on posterior surface; all tibiae and metatarsal joints yellowish; the other joints of tarsi yellowish, except last joint of first pair and last two joints of last two pairs are black; the face, front and most of thorax covered with appressed, rather dense (in some places), yellowish (golden) pubescence, and some light-colored upright hair; antennae yellowish beneath, brown to blackish above; clypeus covered with rather long appressed forward-directed hairs which are more silvery than yellowish; clypeus strongly arched in middle and not quite 2.0 as broad as long, extending under eyes and with the apical margin not quite 0.8 as long as base as the sides slope toward center; apical margin slightly convex; lower interocular distance (100) equal to the upper; the middle interocular distance 0.57 the transfacial; head 1.1 as broad as long; ratio of lengths of first four antennal joints is 55:20:80:65, thus the second and third joint equal to vertex width; pronotum very short, slightly concave on posterior margin; metapostnotum about 0.5 as wide as postscutellum and finely transversely ridged; wings strongly yellowish iridescent with traces of greenish in reflected light, almost hyaline (slightly yellowish) in incident light, veins and stigma yellow; venation normal.

Length of head and thorax 5.3 mm., abdomen 5.3 mm., forewings 9.9 mm., rear wings 7.7 mm.

Holotype female: Nova Teutonia, Brazil, Sept. 22, 1944, Fritz Plaumann (Cal.).

Paratypes: 1, same data as holotype except date Nov. 26, 1944 (RRD); 1, same data except date Mar. 8, 1942 (Cal.).

77. *Auplopus ater*, new species

FIGURES 72, 73

Holotype male. Front and vertex almost black, slightly shining and with metallic tint; ventral surface of thorax almost same color; pronotum, scutellum, and postscutellum about same color as head; mesonotum and propodeum and sides of thorax a greenish color, faintly shining; abdomen blackish with faint iridescence, the apex of all tergites slightly rufous and last tergite white; forecoxae completely yellowish, the second pair dark rufous mottled with black and the third pair blackish; first pair trochanters yellowish the last two pairs black and slightly yellowish; all femora and tibiae yellow; only last two joints of foretarsi dark but almost all of last two pairs dark; antennae rufous below, black above; sides of clypeus (about 0.6), the sides of face to the antennae and slightly above, the mouth

parts, and the mandibles (except extreme base black and extreme apex red), yellowish white; wings hyaline, but shining in reflected light, veins and stigma black; clypeus with a broad transparent rim across front, and across the sides which slope inward toward front of clypeus, the truncate apex only 0.75 as wide as base; clypeus 2.0 as broad as long; the lower interocular distance (70) equal to the upper and the middle interocular distance 0.58 the transfacial; the interior orbits parallel, very slightly bowed just before the vertex; head slightly broader than wide; lateral ocelli not quite 2.0 as far from eyes as from each other; ratio of lengths of first four antennal joints is 30:15:40:35; parameres of genitalia very broad; a very small triangular area on the base of subgenital plate which is closed before the middle and a narrow sharp ridge extending to apex.

Length head and thorax 4.0 mm., abdomen 3.3 mm., forewing 5.9 mm., rear wing 3.0 mm.; length genitalia 0.73 mm., width 0.4 mm., length subgenital plate 0.77 mm., width 0.46 mm.

Holotype male: Nova Teutonia, Brazil, Sept. 11, 1949, Fritz Plaumann (Cal.).

78. *Auplopus pratentis*, new species

FIGURES 70, 71

Holotype male. Front and vertex a faint metallic greenish tint; thorax with green and blue tints, the mesonotum and sides with a strong purple reflection; abdomen slightly bluish, the sides of first tergite yellowish and the last tergite white; coxae and trochanters mostly blackish, the front pair coxae yellowish beneath; all femora (except extreme base is black) and first two pairs tibiae yellowish; last pair tibiae slightly dark rufous at base and beneath, rest darker; first metatarsal joint and most of second, yellowish; the rest of first two pairs and all the last dark; antennae yellowish beneath, black above; the first joint white beneath; a white stripe across front of clypeus and the sides white on about 0.6 of breadth of clypeus; face white except a black streak below antennae, the white touching antennae on sides and the color narrowing to a point on inner orbits a little above antennae; mandibles black at base, yellow in middle, red at apex; mouth parts dull yellowish; underside of thorax same color as coxae, a shining light blackish; a transparent rim across apex and sides of clypeus, apex truncate and 0.7 as broad as base of clypeus; clypeus 2.3 as broad as long; the lower interocular distance (70) equal to the upper but the anterior orbits just below vertex are concave giving the impression that the upper orbits are convergent, middle interocular distance almost 0.6 the transfacial; head more than 1.3 as broad as long; ratio of lengths of first four antennal joints is 30:16:45:45; lateral ocelli slightly farther from eyes than from each

other; wings hyaline with a bright yellow reflection with greenish spots, veins and stigma dark; parameres rather slender for the genus; the volsellae very broad, the emargination at apex narrow and shallow; the subgenital plate with a narrow, long, strong triangle which becomes closed about apical 0.25.

Length head and thorax 4.6 mm., abdomen 4.3 mm., forewing 6.7 mm., rear wings 4.0 mm.; length genitalia 0.53 mm., width 0.29 mm., length subgenital plate 0.79 mm., width 0.40 mm.

Holotype male: Nova Teutonia, Brazil, Apr. 9, 1952, Fritz Plaumann (Cal.).

79. *Auplopus pygidialis*, new species

Holotype female. Head and thorax with a plainly noticeable bluish green color with strong purplish reflection, the color not bright shining; abdomen and all legs beginning with the coxae (except last three tarsal joints of last two pairs) a bright reddish color; mouth parts a light yellow, mandibles yellowish with a reddish apex; antennae brown slightly yellowish beneath; clypeus rounded in front as usual, slightly reddish in middle of front, 2.0 as broad as long; head very broad, 1.3 as broad as long; eyes very broad, the middle interocular distance only 0.5 the transfacial; the lower interocular distance (85) is 1.1 the upper (75); lateral ocelli slightly farther from eyes than each other; ratio of lengths of first four antennal joints is 50:20:90:80; wings hyaline with strong slightly yellow reflection with greenish tints, stigma, and veins yellow; face, clypeus, and certain spots on thorax silvery, shining pubescent.

Length head and thorax 5.6 mm., abdomen 5.0 mm., forewing 9.2 mm., rear wing 6.6 mm.

Holotype female: Amazon, W. Bates (Munich Mus.).

80. *Auplopus editorialis*, new species

FIGURE 75

Holotype male. Head, thorax, and abdomen black, except for a white streak on each side of face which extends on anterior orbits from clypeus to the base of antennae, and for the first abdominal segment which has a reddish tinge, especially on the sides; all coxae and trochanters black except the first pair trochanters are slightly rufous; first two pairs femora and tibiae rufous, except the femora and tibiae of second pair are dark at base and apex; last femora rufous but dark at base and apex; hind tibiae dark above, dark red beneath; foretarsi yellowish, last two pairs dark; antennae dull rufous; mouth parts brown, mandibles dark on basal half, the apical half yellowish and then reddish on apex; silvery pubescence on face, clypeus, and thorax; clypeus as usual on apical margin, 2.0 as broad

as long; middle interocular distance 0.6 the transfacial; head not quite 1.2 as broad as long; lower interocular distance (60) is equal to the upper; lateral ocelli 1.5 as far from head as from each other; ratio of length of first four joints of antennae is 25:10:50:45; wings slightly brownish; third cubital cell does not extend as far as apex of marginal.

Length of head and thorax 3.9 mm., abdomen 3.9 mm., forewing 6.6 mm., rear wing 5.0 mm.

Holotype male: Predras, Ecuador, 300M., July 2, 1941, David Ladden (MCZ).

81. *Auplopus viridulus*, new species

FIGURE 74

Holotype male. Front and vertex a dull green with only a very faint trace of violaceous in certain light; thorax a bright shining green with a faint trace of violaceous or purplish in certain light; abdomen almost black just a trace of reflected bluish, the last tergite white; all of clypeus except for the middle 0.25, the sides of face almost to the antennae and extending on inner orbits to above antennae (reduced to a narrow line above antennae), and almost apical half of mandibles (apex reddish), yellowish; mouth parts brown; under side of antennae yellowish, joints beyond third joint lost; forecoxae slightly bluish, with apex yellowish; last two pairs coxae a bright shining bluish green; trochanters blackish but with some bluish green color; front and middle femora rufous, middle pair dark bluish at base, fore-tibae same color; last pair femora darker colored, bluish at base with strong purple reflection, apical half somewhat rufous; last two pairs tibae and all the tarsi dark; thorax with spots of silvery pubescence especially at the outer posterior corners of propodeum, the apical third of the latter with very long, rather dense white hairs; the whole thorax with considerable upright hair giving a rough appearance; clypeus with a broad, transparent, hairless rim across the front and on the sloping sides, 2.3 as broad as long; the sloping sides of clypeus reducing the width of apex so that it is only about 0.7 as long as at base, the apex truncate; head a little more than 1.2 as broad as long; the lower interocular distance (70) just about equal to the upper; the middle interocular distance 0.60 the transfacial; the lateral ocelli just about as far from eyes as from each other; ratio of length of first three antennal joints (rest lost) is 35:12:50; posterior edge of pronotum slightly concave, the mesonotum just back of it is a shining black with no color; wings brownish; parameres of genitalia not quite as broad as usual for the genus.

Length of head and thorax 4.0 mm., abdomen 3.3 mm., forewings 6.6 mm., rear wings 4.6 mm.

Holotype male: Rio de Janeiro, Brazil, November (AMNH).

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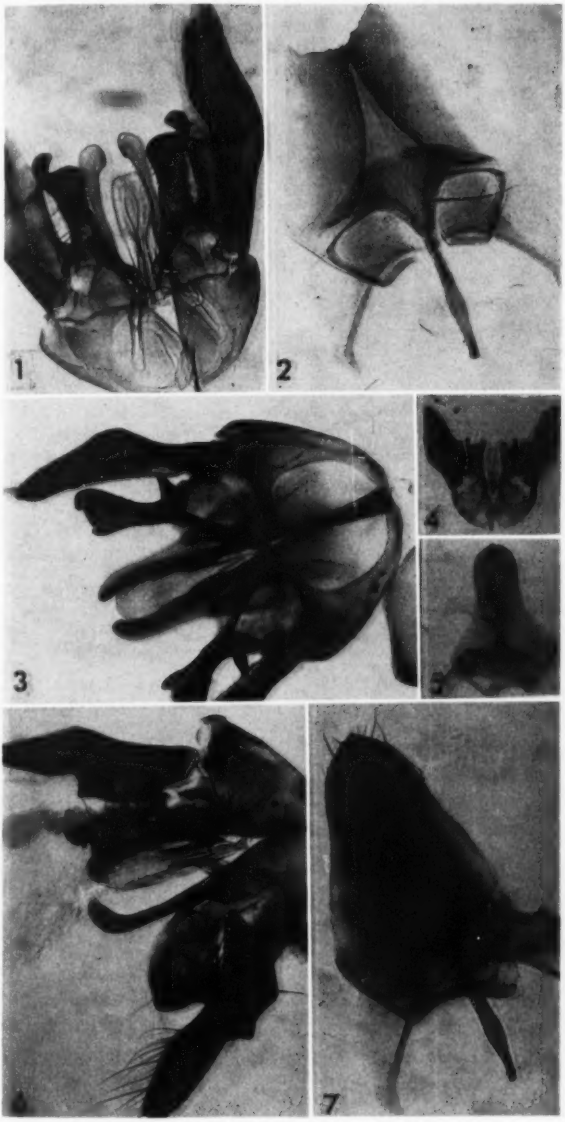
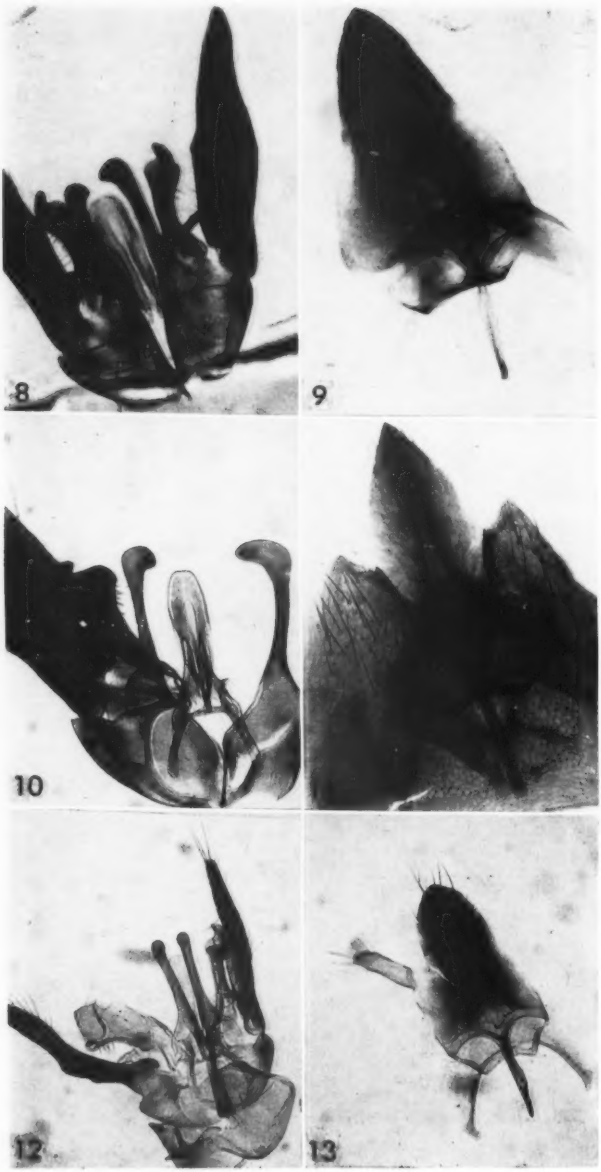
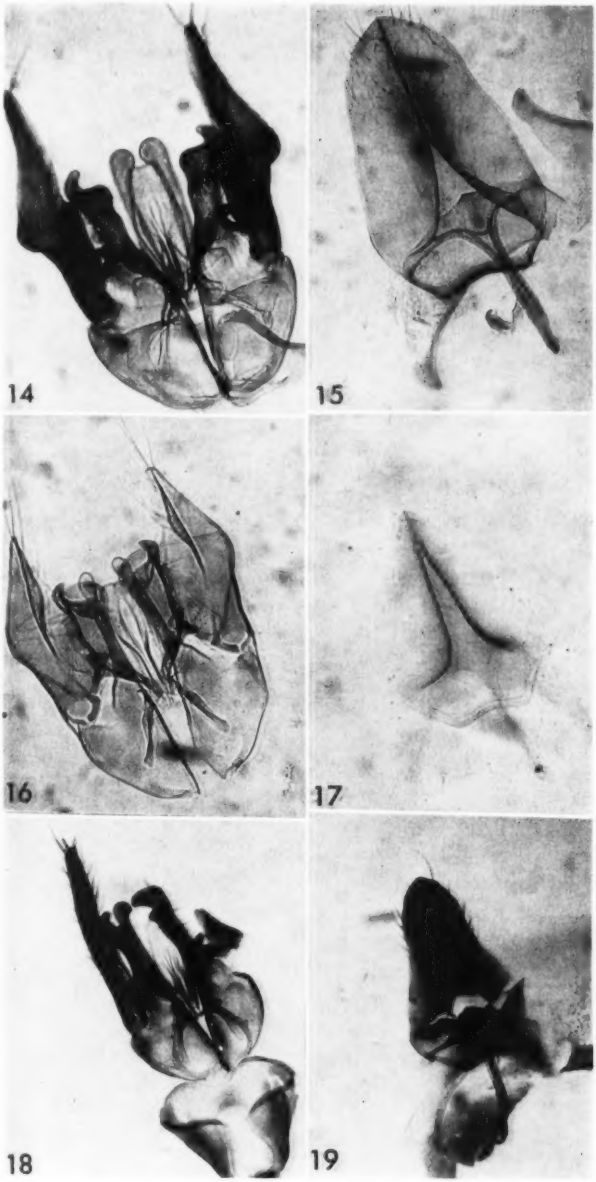


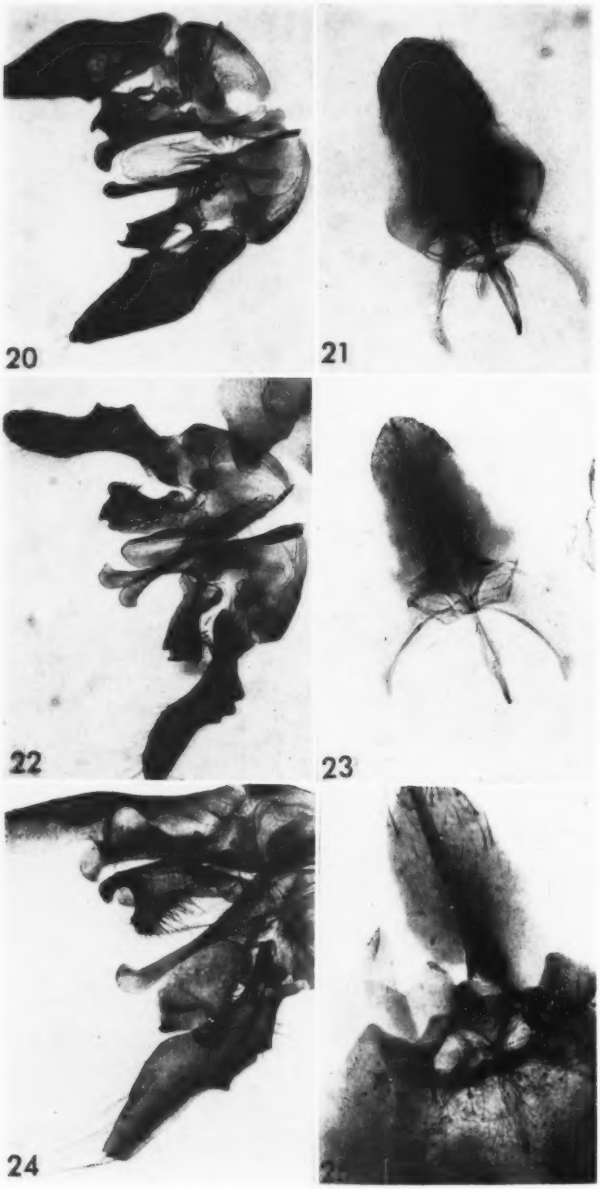
Genitalia of species of *Auplopus*: FIGURES 1, 2, *A. hondurensis*, new species; 3, *A. cyaneus*, new species; 4, 5, *A. bruesi* (Banks); 6, 7, *A. gertschi*, new species.



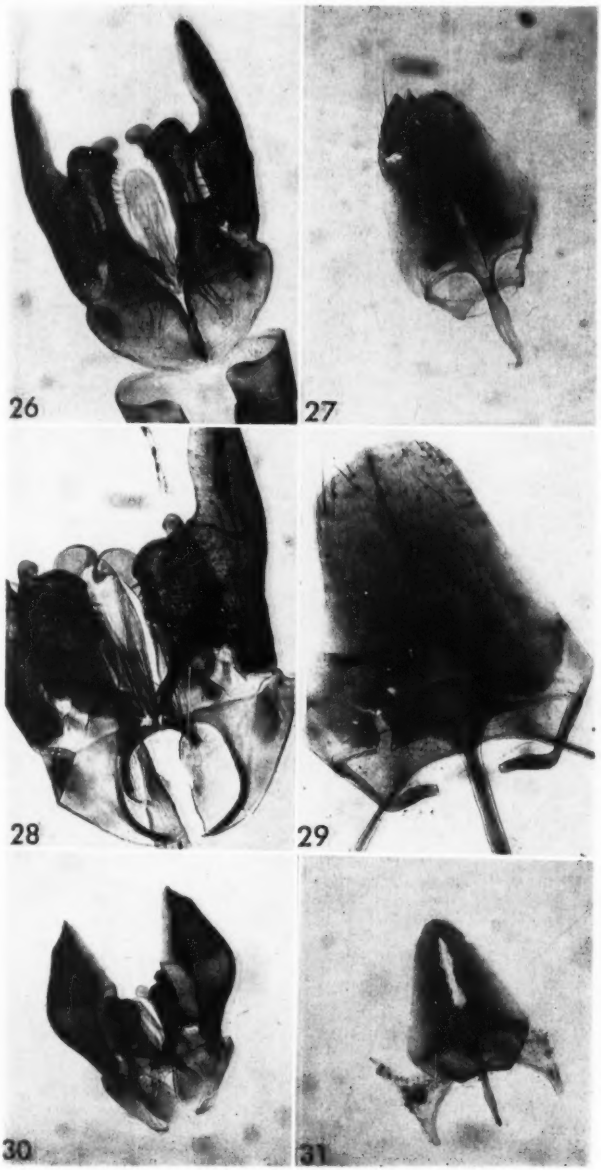
Genitalia of new species of *Auplopus:* FIGURES 8, 9, *A. argentinus;* 10, 11, *A. clypeatus;* 12, 13, *A. abnormalis.*



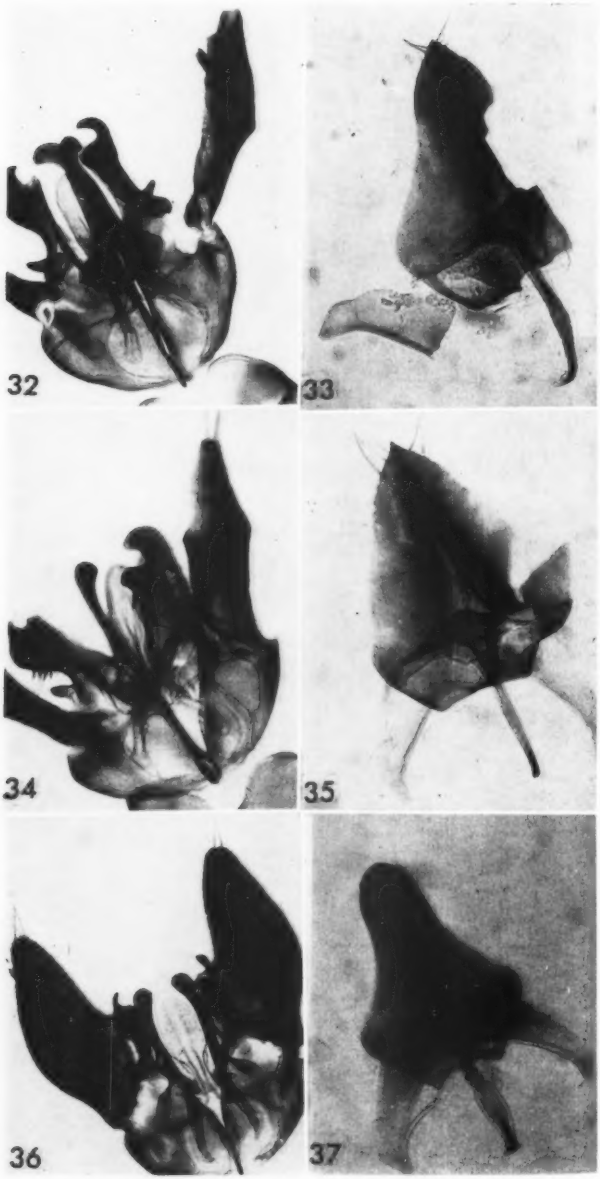
Genitalia of new species of *Auplopus:* FIGURES 14, 15, *A. semialatus*; 16, 17, *A. bequaerti*; 18, 19, *A. aeruginosus*.



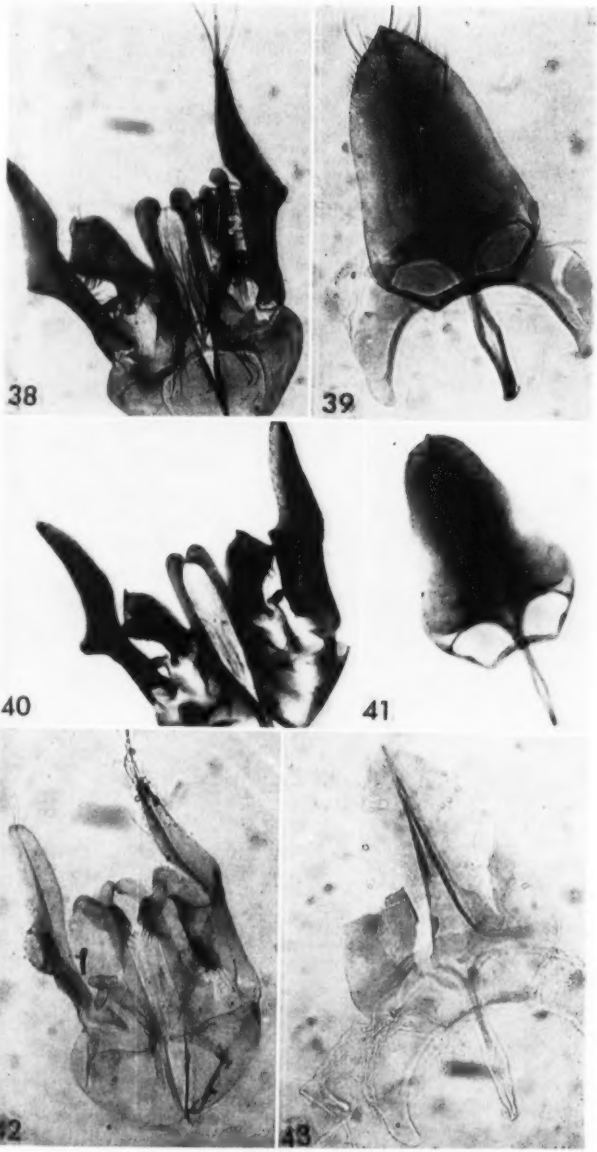
Genitalia of new species of *Auplopus:* FIGURES 20, 21, *A. woodi* (paratype); 22, 23, *A. semirufus;* 24, 25, *A. albifrons.*



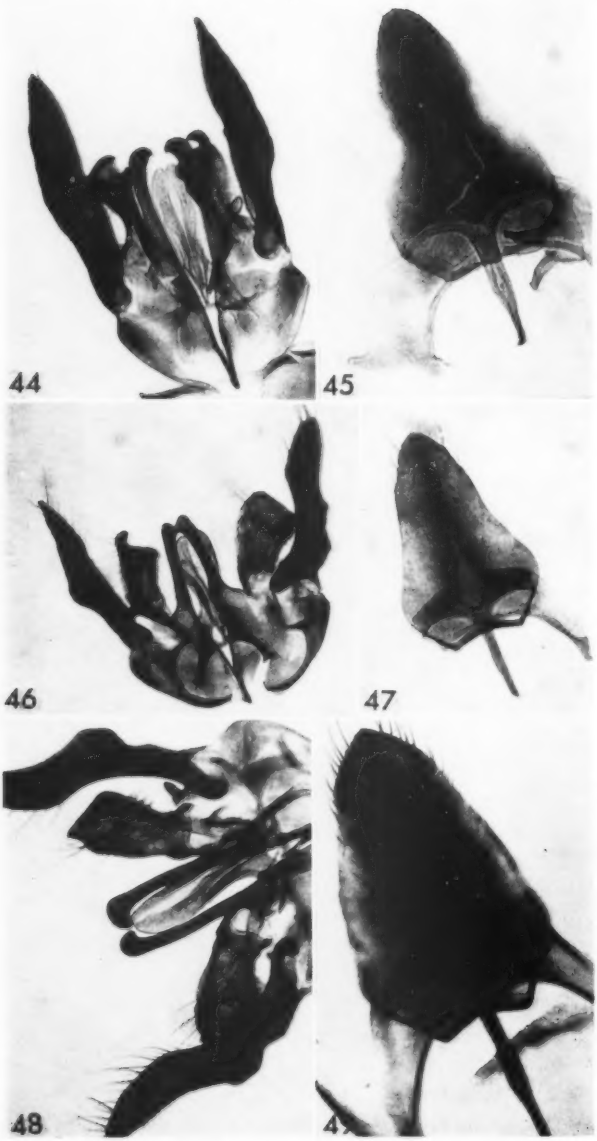
Genitalia of new species of *Auplopus:* FIGURES 26, 27, *A. marginalis;* 28, 29, *A. vulcanensis;* 30, 31, *A. gaumeri.*



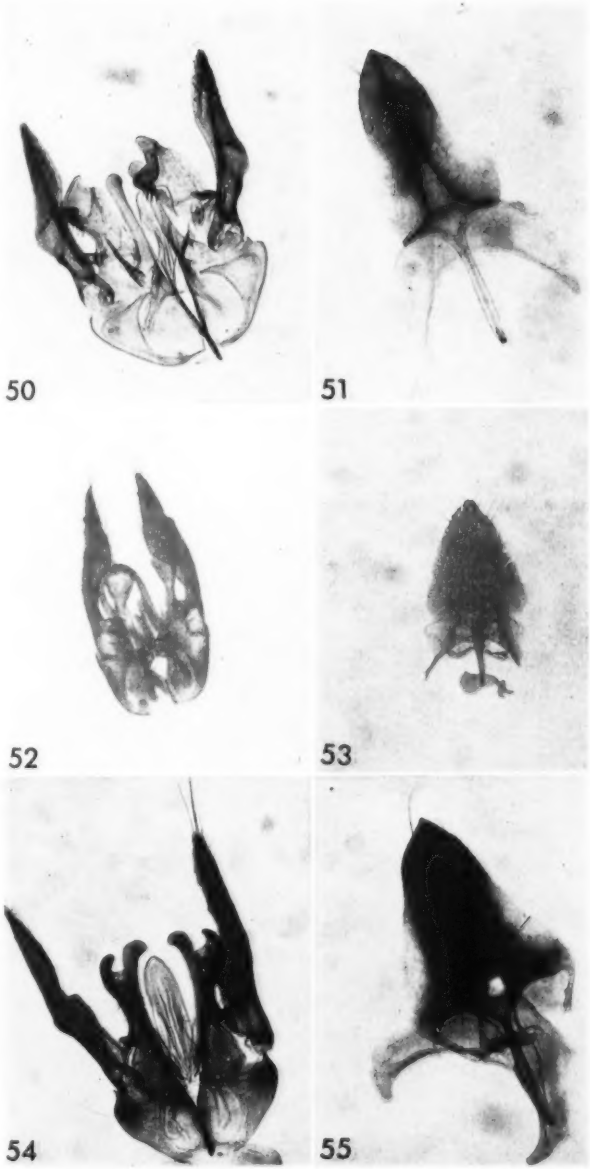
Genitalia of species of *Auplopus*: FIGURES 32, 33, *A. anthracinus*, new species; 34, 35, *A. niger*, new species; 36, 37, *A. bellus* (Cresson).



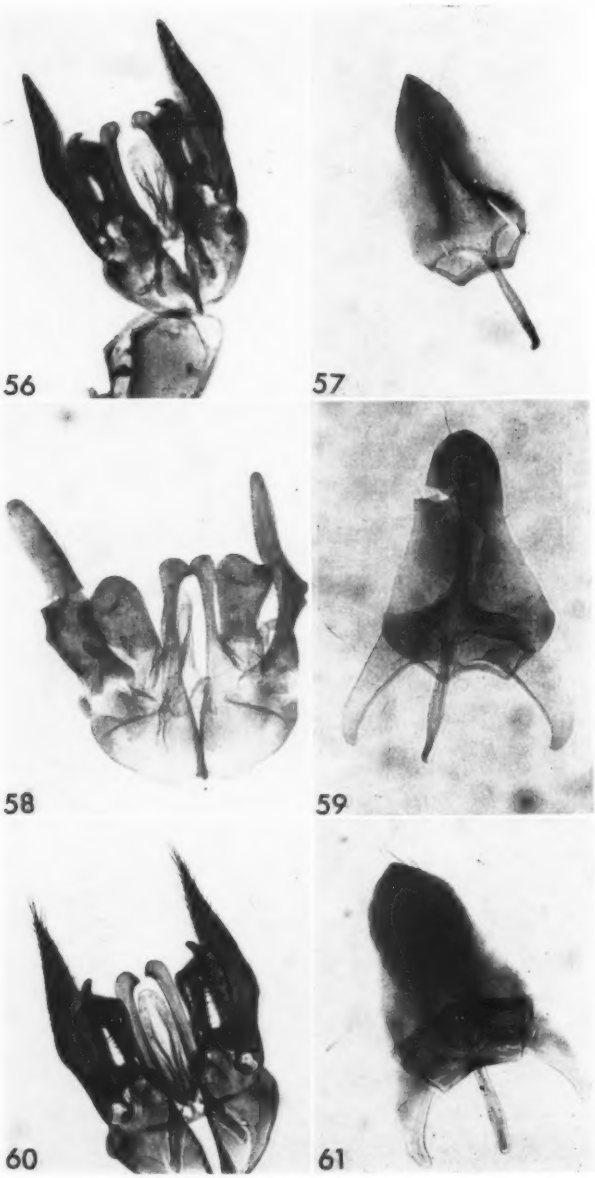
Genitalia of species of *Auplopus:* FIGURES 38, 39, *A. amoenus*, new species; 40, 41, *A. atratus*, new species; 42, 43, *A. femoratus* (Fabricius).



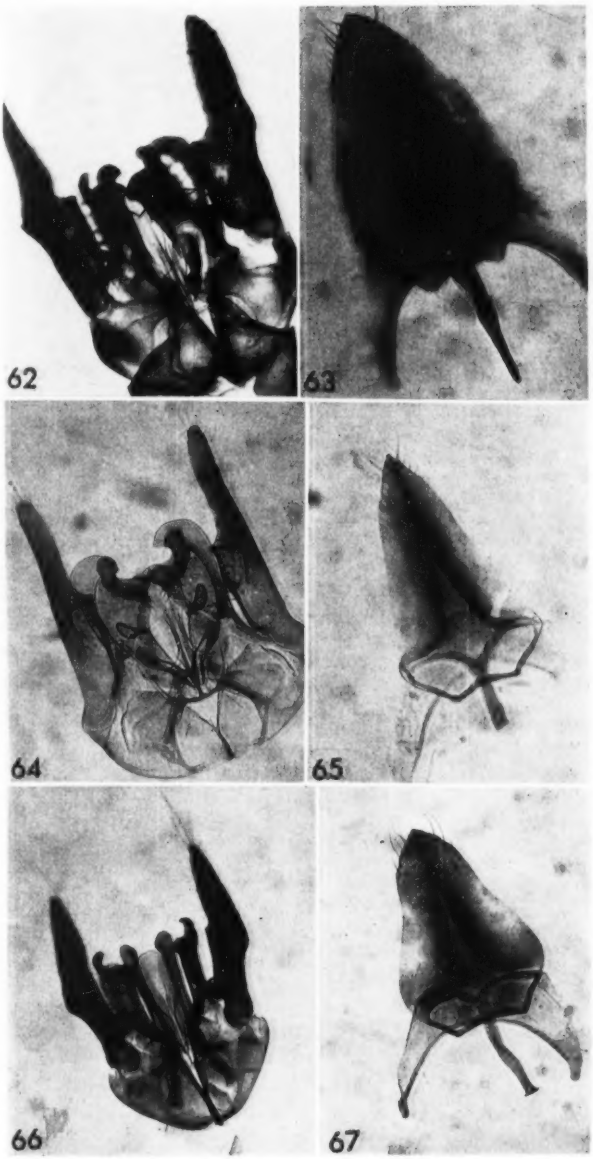
Genitalia of species of *Auplopus:* FIGURES 44, 45, *A. puniceus*, new species; 46, 47, *A. rufipes* (Banks); 48, 49, *A. coracinus*, new species.



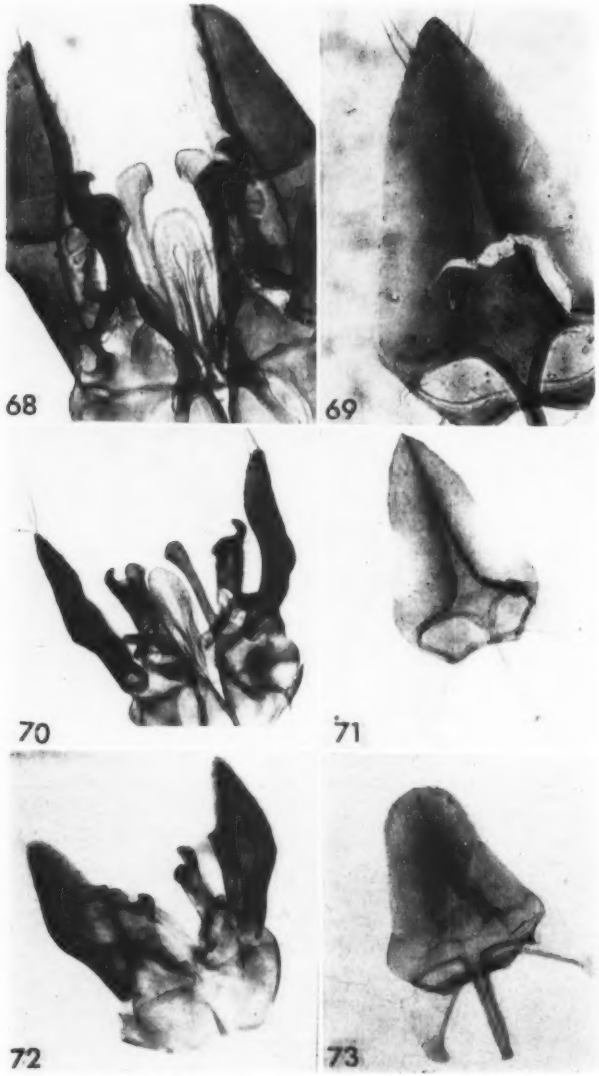
Genitalia: FIGURES 50, 51, *Auplopus cordobensis*, new species; 52, 53, *Ageniella magdalenus* (Banks); 54, 55, *Auplopus schausi*, new species.



Genitalia of species of *Auplopus:* FIGURES 56, 57, *A. stagei*, new species; 58, 59, *A. basalis* Fox; 60, 61, *A. caerulosomus* (Banks).



Genitalia of new species of *Auplopus:* FIGURES 62, 63, *A. brasiliensis;* 64, 65, *A. flavicrus;* 66, 67, *A. Malinus.*



Genitalia of species of *Auplopus*: FIGURES 68, 69, *A. mexicanus* (Cresson); 70, 71, *A. pratentis*, new species; 72, 73, *A. ater*, new species.

FIGURE 74, *Auplopus viridulus*, new species, genitalia; 75, *A. editorialis*, new species, genitalia; 76, *A. atratus*, new species, preapical sternite.

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SOME NORTH AMERICAN MOTHS OF THE GENUS ACLERIS (LEPIDOPTERA: TORTRICIDAE)

By Nicholas S. Obraztsov[1]

The revision of 43 Canadian species of the genus *Acleris* Hübner (*Peronea* Curtis) by McDunnough (1934) remains the most complete paper dealing with the Nearctic moths of this genus. In his later papers the same author gave additional notes on some *Acleris* species and described two as new. Pending a new revision of the entire genus, the present author decided to publish his few notes on the North American *Acleris* species which were made during his main work on a generic revision of the Nearctic Tortricidae. The paper contains systematic, distributional, and biological data on some known species and descriptions of seven new species and one new subspecies. The study is based on the materials in the collections of the United States National Museum (USNM), the American Museum of Natural History (AMNH), the British Museum (Natural History) (BM), and some others.

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Klots and Dr. F. H. Rindge (New York), and Mr. J. D. Bradley (London), who enabled him to use the materials of the above museums. A special acknowledgement goes to Dr. W. E. Forster (Zoologische Sammlung des Bayerichen Staates, Munich, Germany) who placed at the author's disposal a collection of genitalia slides of the European *Acleris* species, made by the author during his work in Germany.

Acleris macdunnoughi, new species

FIGURE 1; PLATE 1 (FIG. 1)

Teras schalleriana.—Fernald (not Linné), 1882, Trans. Amer. Ent. Soc., vol. 10, p. 8.—Grote, 1882, New check list of North American moths, p. 57, no. 17.

Alceris [sic] *schalleriana.*—Fernald, [1903], U.S. Nat. Mus. Bull. 52, p. 474, no. 5315, 1902.

Peronea schalleriana.—Meyrick, 1912, *in* Wagner, Lepidopterorum catalogus, pt. 10, p. 62 (in part); 1913, *in* Wytsman, Genera insectorum, fasc. 149, p. 62 (in part).—Barnes and McDunnough, 1917, Check list of the Lepidoptera of Boreal America, p. 178, no. 7420.—Forbes, [1924], Cornell Univ. Agr. Exp. Stat. Mem. 68, p. 485, 1923.

Peronea latifasciana.—McDunnough (not Haworth), 1934, Canadian Journ. Res., vol. 11, pp. 296, 325 (fig. 5), 329 (fig. 7); 1939, Mem. Southern California Acad. Sci., vol. 2, p. 58, no. 7478.

Peronea latifasciana form *labeculana.*—McDunnough (not Freyer), 1934, Canadian Journ. Res., vol. 11, p. 296.

Antennae dark brown, slightly shot with ochreous, with fine whitish annulation; at underside somewhat darker without such annulation. Head and body ruddy brown. Forewings whitish brown-gray with fine dark-brown transverse, sometimes obliterate striation. Basal quarter of forewing and a large triangular or trapezoidal costal spot ruddy brown or black-brown. Often this spot is continued dorsad as a transverse fascia reaching the vein A_{2+3}, or the entire external part of forewing is ruddy brown. Some specimens have no other markings of forewings but the costal spot. Cilia brownish gray, sometimes mixed with whitish scales. Length of forewing, 8–9 mm. Hind wings smoky brownish with cilia somewhat paler.

MALE GENITALIA.—Tegumen rather broad; gnathos with a distinct ventroapical keel; socii very large, erect, extending beyond apex of tegumen. Valvae elongate with distinct subtriangular cucullus; brachiola rather narrow; sacculus narrowly emarginate beyond half, with outer edge of emargination produced downward and forming an acute spine on lower angle of cucullus; external tuft well developed. Aedoeagus short, stout, slightly bent; vesica with 6 to 10 rather thick spinelike, almost equally sized cornuti arranged in two groups.

FEMALE GENITALIA.—Sterigma with moderately long parallel lateral lobes suddenly dilated at base. Ostium bursae indicated by a long narrow split. Antrum large, slightly sclerotized, with a short wide blind prominence cephalad. No separate ductus bursae; ductus

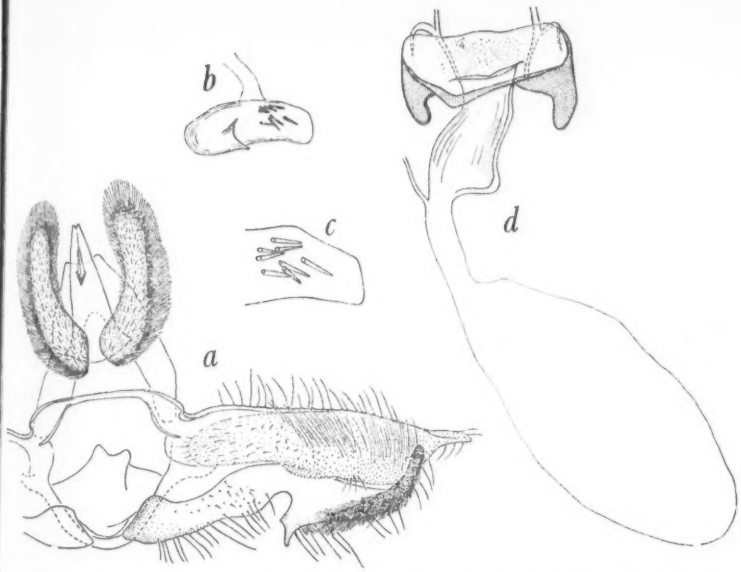

FIGURE 1.—*Acleris macdunnoughi*, new species: *a*, male genitalia with aedoeagus removed (slide 411-Obr.); *b*, aedoeagus; *c*, cornuti (more enlarged); *d*, female genitalia (slide 412-Obr.).

seminalis joining close to antrum. Cervix bursae short; corpus bursae elongate without signum.

TYPES.—Holotype, female (genitalia on slide, prepared by A. Busck, Mar. 12, 1935), Winchendon, Mass., Sept. 29, 1902; allotype, male, same locality, Sept. 23, 1902; both in USNM (No. 65585). Paratypes: four males (genitalia on slides, prepared by A. Busck, Feb. 2, 1922; Nov. 2, 1924; Mar. 12 and 13, 1935), same locality, Sept. 23, 26, and 29, 1902, USNM; eight males and three females (genitalia on slides 411–Obr., 412–Obr., 460–Obr., and 461–Obr.), same locality, Sept. 6–Oct. 12, 1902, AMNH. All types originate from Kearfott Collection.

OTHER SPECIMENS EXAMINED.—One male (genitalia on slide 430–Obr.), Winnipeg, Manitoba (A. W. Hanham), AMNH; one slide with male genitalia (prepared by A. Busck, Mar. 11, 1924), Meach Lake, Quebec (C. H. Young), moth not located, USNM; one male, Catskill Mountains, N.Y. Aug. 29, 1905, AMNH.

REMARKS.—This is the Nearctic species confused in the collections and literature for the Palearctic *Acleris latifasciana* (Haworth) (*schalleriana* auctorum, not Linné), which it really resembles. McDun-

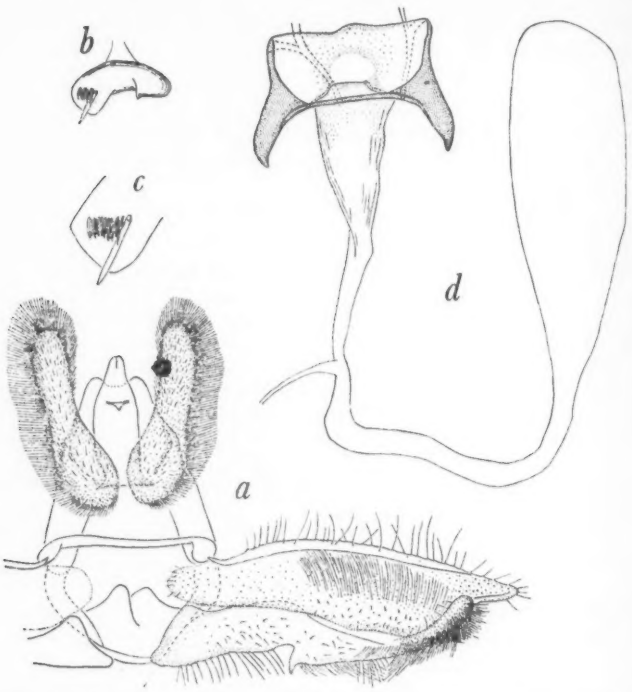

FIGURE 2.—*Acleris latifasciana* (Haworth): *a*, male genitalia with aedoeagus removed (slide 410-Obr., England, AMNH); *b*, aedoeagus; *c*, cornuti (more enlarged); *d*, female genitalia (slide 413-Obr., Brighton, Essex, England, AMNH).

nough (1934) first described and figured the genitalia of this species, and the present author takes pleasure in naming it for the late investigator of the Canadian *Acleris* species. In *latifasciana* (fig. 2), the ventroapical spine of the gnathos is more flat than in *macdunnoughi*, the emargination of the sacculus of the valva is not so deep and is situated slightly more basad, and the vesica has one long thick cornutus and many shorter ones. The lateral lobes of the sterigma in the female genitalia of *latifasciana* are not dilated basad as in *macdunnoughi*, and the antrum is membranous without any lateral prominence.

Acleris comariana (Zeller)

Teras comariana Zeller, 1846, Isis, p. 263.—Herrich-Schäffer, 1850, Systematische Bearbeitung der Schmetterlinge von Europa, vol. 4, Tortricides, pl. 54, fig. 387; 1851, Systematische Bearbeitung der Schmetterlinge von Europa, vol. 4, p. 153.—Lederer, 1859, Wiener Ent. Monatschr., vol. 3, p. 152.—Wocke, 1861, *in* Staudinger and Wocke, Catalog der Lepidopteren Europa's, p. 94,

no. 561.—Walker, 1863, List of the specimens of lepidopterous insects in the British Museum, pt. 27, p. 208.—Snellen, 1882, Vlinders van Nederland, Microlepidoptera, p. 188.—Sorhagen, 1882, Berliner Ent. Zeitschr., vol. 26, p. 129; 1901, Allgem. Zeitschr. Ent., vol. 6, p. 312.

Teras comparana aberration *comariana*.—Wocke, 1871, *in* Staudinger and Wocke, Catalog der Lepidopteren des europaeischen Faunengebiets, p. 234, no. 673b.

Peronea comariana.—Nolcken, 1871, Ent. Monthly Mag., vol. 7, p. 233.—Barrett, 1905, Lepidoptera of the British Islands, vol. 10, p. 243, pl. 455, figs. 4, 4a.—Meyrick, 1912, *in* Wagner, Lepidopterorum catalogus, pt. 10, p. 62; 1913, *in* Wytsman, Genera insectorum, fasc. 149, p. 62.—Sheldon, 1925, The Ent., vol. 58, p. 281.—Meyrick, 1927, Revised handbook of British Lepidoptera, p. 523.—Kemner, 1927, Meddel. Centralanst. Försöksväsendet Jordbruksomradet, no. 315, ent. avd., no. 50, pp. 1–37, figs. 1–9.—Sheldon, 1931, The Ent., vol. 64, p. 33.—Lhomme, 1939, Catalogue des lépidoptères de France et de Belgique, vol. 2, p. 292.—Benander, 1946, Opuscula Ent. (Lund), vol. 11, p. 16; 1950, Svensk Insektfauna, pt. 10, p. 19, text figs. 1a and 3r.

Acalla comariana.—Meyrick, 1895, Handbook of British Lepidoptera, p. 524.—Rebel, 1901, *in* Staudinger and Rebel, Catalog der Lepidopteren des palaearctischen Faunengebietes, vol. 2, p. 83, no. 1470.—Kennel, 1908, Die palaearktischen Tortriciden, p. 92.—Benander, 1928, Ent. Tidskr., vol. 49, p. 135, 1934, Ent. Tidskr., vol. 55, p. 122, pl. 1, fig. 1.—Schütze, 1931, Biologie der Kleinschmetterlinge, p. 111.—Dufrane, 1945, Lambillionea, vol. 45, p. 33.—Heddergott, 1953, *in* Blunck, Handbuch der Pflanzenkrankheiten, vol. 4, pt. 1, fasc. 2, p. 107.

Ozygrapha comariana.—Petherbridge, 1920, Ann. Appl. Biol., vol. 7, p. 6, pl. 1.

Argyotoxa [sic] *comparana* (by mistake).—Pierce and Metcalfe, 1922, Genitalia of the group Tortricidae, pl. 7.

Argyotoxa [sic] *comariana*.—Pierce and Metcalfe, 1922, Genitalia of the group Tortricidae, p. 17; 1935, Genitalia of the tineid families, p. 114.

Acalla meincki Amsel, 1930, Mitt. Deutschen Ent. Ges., vol. 1, p. 50; 1930, Iris, vol. 44, p. 100; 1932, Deutsche Ent. Zeitschr., p. 24, pl. 1, fig. 4.

Peronea latifasciana var. *comparana* (by mistake).—McDunnough, 1934, Canadian Journ. Res., vol. 11, p. 297; 1939, Mem. Southern California Acad. Sci., vol. 2, p. 58, no. 7478a.

Acleris comariana.—Obraztsov, 1956, Tijdschr. Ent., vol. 99, p. 129 (synonymy and list of individual forms).

McDunnough (1934) mentioned as var. *comparana* a species of the group *latifasciana*, recorded in Canada. He wrote that this species has been "frequently intercepted in the larval or pupal state on azaleas imported from Holland and Belgium," and it "appears to show constant, slight genitalic differences which may indicate specific or at least racial distinctness," in comparison to another Canadian species which McDunnough called *latifasciana* and which in fact is a new species described in the present paper as *macdunnoughi*. As noted by McDunnough, the genitalia of the species found in Canada on imported azaleas "agree remarkably well with Pierce's figures of *comparana* Hübner; in the male the anal sheath lacks spiculation, the sacculus emargination is rectangular and the aedeagus is distinctly smaller and without any cornuti." The present author had the opportunity to examine two males and one female of the species men-

tioned by McDunnough, and he has no doubts that these specimens are *Acleris comariana*, a species as yet known from the Palearctic region only. It is no wonder that McDunnough found the genitalia of this "azalea pest" similar to those figured by Pierce and Metcalfe (1922) as *comparana*, because these figures represent in fact not *comparana* but *comariana*, as Pierce noted in another, more recent paper (Pierce and Metcalfe, 1935).

Some details on the structure of the genitalia of *comariana* are not quite clear from the literature, or they have been omitted or explained incorrectly. The gnathos ("anal sheath") of *comariana* has a weak spiculation which easily can be overlooked in a superficial observation, because the middle keel of the gnathos in this species is flatter and less pointed than in the related *latifasciana*. This keel is present in both males of *comariana* from Canada as in the male from England, examined by the present author. Presence of some fine short cornuti has been established in this English specimen and in some other specimens of *comariana* seen before. These cornuti are of equal length. A single cornutus has been found in a Canadian specimen also. The sacculus of the valva of *comariana* has an almost rectangular emargination which is broader than that of *latifasciana*. The lower angle of the sacculus of *comariana* is rather less pointed. In the female genitalia of this species, the lateral lobes of the sterigma are very typical, being slightly bent inward. The antrum is somewhat shorter than in *latifasciana*, separated quite indistinctly from the ductus bursae, and not sclerotized at all.

It is important to mention that in the European literature *comariana* is known as feeding on *Comarum palustre* and strawberries, but the closely related *latifasciana* Haworth (*schalleriana* auctorum, non Linné) became known as "Azaleenwickler," that is, "azalea leaf roller." This latter species reportedly damages azaleas and roses in greenhouses, and in nature is also injurious to *Rhododendron*, *Vaccinium*, *Salix*, and some other plants, being rather a general feeder (Heddergott, 1953, p. 107). This mention of azaleas and *Rhododendron* as food plants of *latifasciana* is rather suspicious, especially in connection with the fact that Kaven (1934, p. 124), reporting this species as damaging *Rhododendron*, named it "der an Erdbeeren vorkommende Wickler," (strawberry leaf roller). Inasmuch as *comariana* (but not *latifasciana*) is commonly known as a pest of strawberries, we can suppose an error in the identification of the species attacking azaleas and *Rhododendron* in Europe. This error seems to be the more possible because the genitalia of *comariana* and one of the individual forms of *latifasciana* (aberration *comparana*) were reversely confused by Pierce and Metcalfe (1922) whose book is the basic work generally used for identification of European tor-

tricids. The larvae of *latifasciana* and *comariana* are rather similar, and Swatschek (1958, p. 74) is even inclined to treat them as variations of one and the same species. He found, nevertheless, that, in distinction from *latifasciana*, the larva of *comariana* (which he erroneously calls *comparana*) has the cervical shield dark-edged anally and that its thoracic legs and warts are brown. Meyrick (1895, p. 525) and Sorhagen (1901, p. 311) gave dark-green lateral lines as a character of the larva of *comariana*. None of the authors distinguishing between *latifasciana* and *comariana* mention any lateral lines in the larva of the former species. Only Pape (1939, p. 169), describing the larvae of the "Azaleenwickler" under the name *schalleriana*, gives these lines as their character. The problem, whether *comariana* or *latifasciana* is the real "azalea pest" in Europe, cannot be definitively resolved in the present paper, and the answer on this question is expected from the European entomologists. It is, nevertheless, completely clear that the species found in Canada on imported azaleas is *comariana* but not *latifasciana*.

The present note is based on the first authentic record of *comariana* in North America. This species has been known before only from Europe; its record in Kwangtung (Meyrick, 1934; p. 31) is somewhat doubtful.

SPECIMENS EXAMINED.—One male and one female (genitalia on slide, prepared by A. Busck, Oct. 29, 1924), "on azalea from Belgium, imported to Ottawa, Canada, Oct. 24, 1924"; one male (genitalia on slide, prepared by A. Busck, Jan. 11, 1924), Montreal, Quebec; one male and one female (genitalia on slides 3–Obr. and 4–Obr., Oct. 29, 1959), Madeley, England, Sept. 16 and Oct. 8, 1928 (H. C. Hayward). All specimens in USNM.

Acleris ptychogrammos (Zeller), new combination

Teras hastiana var. *ptychogrammos* Zeller, 1875, Verhandl. zool.-bot. Ges. Wien, vol. 25, p. 213.—Walsingham, 1879, Illustrations of typical specimens of Lepidoptera Heterocera, pt. 4, p. 76.—Fernald, 1882, Trans. Amer. Ent. Soc., vol. 10, p. 7.

Alceris [sic] *hastiana ptychogrammos*.—Fernald, [1903], U.S. Nat. Mus. Bull. 52, p. 473, no. 5309g, 1902.

Peronea hastiana (in part).—Meyrick, 1912, *in* Wagner, Lepidopterorum catalogus, pt. 10, p. 68; 1913, *in* Wytsman, Genera insectorum, fasc. 149, p. 64.

Peronea hastiana form *ptychogrammos*.—Barnes and McDunnough, 1917, Check list of the Lepidoptera of Boreal America, p. 178, no. 7439.

Peronea hastiana var. *ptychogrammos*.—Forbes, [1924], Cornell Univ. Agr. Exp. Stat. Mem. 68, p. 486, 1923.

Peronea ptychogrammos.—McDunnough, 1934, Canadian Journ. Res., vol. 11, pp. 293, 325 (fig. 6), 329 (fig. 3); 1939, Mem. Southern California Acad. Sci., vol. 2, p. 58, no. 7474.

FOOD PLANT.—*Cornus stolonifera* (in accordance with label data of a male from Putnam County, Ill., June 29, 1956, M. O. Glenn, in USNM.)

***Acleris nivisellana* (Walsingham)**

Teras nivisellana Walsingham, 1897, Illustrations of typical specimens of Lepidoptera Heterocera, pt. 4, p. 2, pl. 61, fig. 3—Fernald, 1882, Trans. Amer. Ent. Soc., vol. 10, p. 8.—Grote, 1882, New check list of North American moths, p. 57, no. 16.

Alceris [sic] *nivisellana*.—Fernald, [1903], U.S. Nat. Mus. Bull. 52, p. 474, no. 5314, 1902.

Peronea nivisellana.—Meyrick, 1912, *in* Wagner, Lepidopterorum catalogus, pt. 10, p. 63; 1913, *in* Wytsman, Genera insectorum, fasc. 149, p. 63.—Barnes and McDunnough, 1917, Check list of the Lepidoptera of Boreal America, p. 178, no. 7425.—Barnes and Pusck, 1920, Contr. Nat. Hist. Lep. North America, vol. 4, pl. 32, fig. 9.—Forbes, [1924], Cornell Univ. Agr. Exp. Stat. Mem. 68, p. 484, 1923.—Filipjev, [1931], Ann. Mus. Zool. Acad. Sci. URSS, vol 31, pp. 520, 527, and 528; pls. 26 (figs. 1 and 1a), 32 (fig. 3), 1930.—McDunnough, 1934, Canadian Journ. Res., vol. 11, pp. 315, 327 (fig. 6), 332 (fig. 1); 1939, Mem. Southern California Acad. Sci., vol. 2, p. 59, no. 7504; 1940, Canadian Ent., vol. 72, p. 61.

Acleris nivisellana.—Obraztsov, 1956, Tijdschr. Ent., vol. 99, p. 131.

Walsingham established this species on the basis of two specimens which are deposited now in the collection of the British Museum (Natural History). The present author examined both specimens during his visit to London in 1958, and convinced himself of their identity with the species known in the literature as *nivisellana*. These two specimens, one of which becomes now a lectotype, the other a lectoallotype, are not both females as indicated on labels—the lectoallotype is a male. For the collecting locality of this latter specimen, Walsingham named in his paper "near Rouge River," but the original label of the collector reads "Umpqua River." The latter locality seems to be correct, and corresponds to the map in Walsingham's itinerary published by Essig (1941). At the Rogue River (misspelled as "Rouge River" in Walsingham's paper) Walsingham did not collect at all.

TYPES.—Lectotype, female, Mount Shasta, Siskiyou County, Calif., Aug. 2 till Sept. 1, 1871 (Walsingham); lecto-allotype, male, Umpqua River, Douglas County, Oreg., Apr. 28 till May 3, 1872 (Walsingham). Both types in BM.

***Acleris tripunctana* (Hübner)**

?*Pyralis centrana* Fabricius, 1794, Entomologia systematica, vol. 3, pt. 2, p. 273.

Tripunctana Hübner, 1796–1799, Sammlung europäischer Schmetterlinge, Tortrices, pl. 20, fig. 129.

?*Pyralis approximana* Fabricius, 1798, Supplementum entomologiae systematicae, p. 478.

Tortrix rufana.—Haworth (not Schiffermiller and Denis), 1811, Lepidoptera Britannica, p. 417.

Tortrix tripunctulana (in part).—Haworth, 1811, Lepidoptera Britannica, p. 417.

Tortrix ferrugana.—Zincken (not Schiffermiller and Denis), 1821, *in* Charpentier, Die Zinsler, Wickler, Schaben und Geistchen des Systematischen Verzeichnisses der Schmetterlinge der Wiener Gegend, p. 54.—Werneburg, 1864, Beiträge zur Schmetterlingskinde, vol. 1, p. 461.

Eutrachia tripunctana.—Hübner, 1822, Systematisch-alphabetisches Verzeichniss, p. 65.

Acleris triana Hübner, 1825, Verzeichniss bekannter Schmettlinge [sic], p. 384.

?*Tortrix gilvana* Frölich, 1828, Enumeratio Tortricum Würtembergiae, p. 24.

?*Tortrix ochreana*.—Frölich (not Hübner), 1828, Enumeratio Tortricum Würtembergiae, p. 25.

Teras ferrugana.—Treitschke (not Schiffermiller and Denis), 1830, Schmetterlinge von Europa, vol. 8, p. 263 (in part); 1835, Schmetterlinge von Europa, vol. 10, pt. 3, pp. 136 and 261 (in part).—Fischer von Röslerstamm, 1836, Abbildungen zur Berichtigung und Ergänzung der Schmetterlingskunde, p. 40, pls. 23 (figs. a–k), 24 (figs. c and e–h), 25 (figs. 1b and 1e).—Zeller, 1847, Isis, p. 739.—Herrich-Schäffer, 1849, Systematische Bearbeitung der Schmetterlinge von Europa, vol. 4, Tortricides, pl. 57, fig. 407; 1851, Systematische Bearbeitung der Schmetterlinge von Europa, vol. 4, p. 146.—Zeller, 1853, Stettiner Ent. Zeit., vol. 14, p. 54; ?1875, Verhandl. zool.-bot. Ges. Wien, vol. 25, p. 212.—Lederer, 1859, Wiener Ent. Monatschr., vol. 3, p. 155.—Wocke, 1861, *in* Staudinger and Wocke, Catalog der Lepidopteren Europa's, p. 95, no. 579.—Walker, 1863, List of the . . . lepidopterous insects in the British Museum, pt. 27, p. 211.—Heinemann, 1863, Schmetterlinge Deutschlands und der Schweiz, Abth. 2, vol. 1, pt. 1, p. 25 (in part).—Sorhagen, 1882, Berliner Ent. Zeitschr., vol. 26, p. 130.—?Fernald, 1882, Trans. Amer. Ent. Soc., vol. 10, p. 8 (in part).—?Grote, 1882, New check list of North American moths, p. 57, no. 18.—Bentinck, 1936, Tijdschr. Ent., vol. 79, pp. 200 and 205.

Paramesia tripunctana.—Curtis, 1833, British entomology, expl. pl. 440.

Peronea (*Acleris*) *costimaculana* Stephens, 1834, Illustrations of British entomology, Haustellata, vol. 4, p. 160.

Peronea costimaculana.—Curtis, post 1834, British entomology. . ., expl. pl. 16, p. 8.—Wood, 1839, Index entomologicus, p. 159, pl. 36, fig. 1087.—(Stephens, 1829, Systematic catalogue of British insects, pt. 2, p. 187, no. 7084; nomen nudum.)

Teras ferrugana var. (and/or aberration) *tripunctana*.—Treitschke, 1835, Schmetterlinge von Europa, vol. 10, pt. 3, pp. 136 and 262.—Herrich-Schäffer, 1851, Systematische Bearbeitung der Schmetterlinge von Europa, vol. 4, p. 146.—Walker, 1863, List of the specimens of lepidopterous insects in the British Museum, pt. 27, p. 212.—Wocke, 1871, *in* Staudinger and Wocke, Catalog der Lepidopteren des europaeischen Faunengebiets, p. 235, no. 676a.—Snellen, 1882, Vlinders van Nederland, Microlepidoptera, p. 185.—Wallengren, 1888, Ent. Tidskr., vol. 9, p. 167.

Glyphiptera tripunctana.—Duponchel, 1835, Histoire naturelle des lépidoptères ou papillons de France, vol. 9, p. 141, pl. 243, fig. 2.

?*Teras longulana* Eversmann, 1844, Fauna lepidopterologica Volgo-Uralensis, p. 525.

Teras proteana Guenée, 1845, Ann. Soc. Ent. France, ser. 2, vol. 3, p. 146; [1846], Europaeorum Microlepidopterorum index methodicus, p. 12, 1845.—Heinemann, 1863, Schmetterlinge Deutschlands und der Schweiz, Abth. 2, vol. 1, pt. 1, p. 25.—de Joannis, 1919, Ann. Soc. Ent. France, vol. 88, p. 5.

Glyphiptera ferrugana var. *tripunctana* Duponchel, 1845, Catalogue méthodique des lépidoptères d'Europe, p. 293.

?*Glyphiptera longulana*.—Duponchel, 1845, Catalogue méthodique des lépidoptères d'Europe, p. 293.

Acleris costimaculana.—Westwood and Humphreys, 1845, British moths and their transformations, vol. 2, p. 163, pl. 96, fig. 1.

Peronea (*Acleris*) *comparana*.—Stephens (not Hübner), 1852, List of the specimens of British animals in the British Museum, pt. 10, p. 18 (in part).

Paramesia ferrugana.—Stephens, 1852, List of the specimens of British animals in the British Museum, pt. 10, p. 20. Wilkinson, 1859, British tortrices, p. 178.—Stainton, 1859, Manual of British butterflies and moths, vol. 2, p. 235.

Teras comparana (in part).—Walker, 1863, List of the specimens of lepidopterous insects in the British Museum, pt. 27, p. 211.

Tortrix approximana.—Werneburg, 1864, Beiträge zur Schmetterlingskunde, vol. 1, p. 461.

Acalla ferrugana.—Meyrick, 1895, Handbook of British Lepidoptera, p. 525.—Rebel, 1901, *in* Staudinger and Rebel, Catalog der Lepidopteren des palaerctischen Faunengebietes, vol. 2, p. 83, no. 1473 (in part).—Kennel, 1907, *in* Spuler, Schmetterlinge Europas, vol. 2, p. 244, pl. 83, fig. 22; 1908, Die palaearktischen Tortriciden, p. 93, pl. 5, fig. 44.—Benander, 1929, Ent. Tidskr., vol. 50, p. 133, figures 9a-f: 1934, Ent. Tidskr., vol. 55, p. 124, pl. 2, fig. 2.—Escherich, 1931, Forstinsekten Mitteleuropas, vol. 3, text fig. 183c (right side), pl. 2, fig. 1b.—Hering, 1932, *in* Brohmer, Ehrmann, and Ulmer, Tierwelt Mitteleuropas, suppl. 1, p. 242, fig. 437.—Eckstein, 1933, Schmetterlinge Deutschlands, vol. 5, p. 71, pl. 3, fig. 91.

Acalla ferrugana var. (and/or aberration) *tripunctana*.—Rebel, 1901, *in* Staudinger and Rebel, Catalog der Lepidopteren des palaearctischen Faunengebietes, vol. 2, p. 83, no. 1473a.—Kennel, 1907, *in* Spuler, Schmetterlinge Europas, vol. 2, 244; 1908, Die palaearktischen Tortriciden, p. 94, pl. 5, fig. 42.—Escherich, 1931, Forstinsekten Mitteleuropas, vol. 3, p. 220.

?*Alceris* [sic] *ferrugana* (in part).—Fernald, [1903], U. S. Nat. Mus. Bull. 52, p. 474, no. 5316, 1902.

Peronea schalleriana (in part).—Meyrick, 1912, *in* Wagner, Lepidopterorum catalogus, pt. 10, p. 62; 1913, *in* Wytsman, Genera insectorum, fasc. 149, p. 62.

Peronea ferrugana.—Meyrick, 1912, *in* Wagner, Lepidopterorum catalogus, pt. 10, p. 60; 1913, *in* Wytsman, Genera insectorum, fasc. 149, p. 62; 1927, Revised handbook of British Lepidoptera, p. 522.—?Barnes and McDunnough, 1917, Check list of the Lepidoptera of Boreal America, p. 178, no. 7413.—Pierce and Metcalfe, 1922, Genitalia of the group Tortricidae, p. 21, pl. 8.—Filipjev, [1931], Ann. Mus. Zool. Acad. Sci. URSS, vol. 31, pp. 504-506, 508, 522, and 526; pls. 25 (fig. 3), 28 (fig. 3) 1930.—McDunnough 1934, Canadian Journ. Res., vol. 11, p. 321; 1939, Mem. Southern California Acad. Sci., vol. 2, p. 59, no. 7513.—Sovinskij, 1937, Trav. Mus. Zool. (Kiev), vol. 19, p. 32, pls. 1 (figs. 1, 3, and 4); 2 (fig. 7).—Benander, 1950, Svensk Insektfauna, pt. 10, p. 21, text fig. 3k, pl. 1 (fig. 18).

Acleris ferrugana form *brachiana*.—Sheldon, 1931, The Ent., vol. 64, p. 61 (in part).

Peronea ferrugana tripunctana.—Lhomme, 1939, Catalogue des lépidoptéres de France et de Belgique, vol. 2, pt. 2, p. 289.

Acleris ferrugana.—Wolff, 1952, Ent. Tidskr., vol. 73, p. 59.—Benander, 1954, Opuscula Ent. (Lund), vol. 19, p. 100, fig. 1d.

Acleris tripunctana.—Obraztsov, 1956, Tijdschr. Ent., vol. 99, p. 132 (synonymy and list of individual forms); 1957, Tijdschr. Ent., vol. 100, p. 327 (nomenclature and diagnostics).

This is the species usually treated in the literature as *ferrugana*. Because the true *ferrugana* Schiffermiller and Denis is another Palearctic species, known also as *fissurana* Pierce and Metcalfe, the name of the present species was replaced by *tripunctana* Hübner (Obraztsov, 1957). McDunnough (1934) mentioned two specimens of *tripunctana* (*ferrugana* auctorum) from Canada, the genitalia of which agreed with those of the European specimens of this species. In the markings of forewings, these specimens were similar to the figure 43 of Kennel (1908, pl. 5) which represents the aberration *galacteana* Krulikovskij of *tripunctana*.

The present author examined a male specimen from New Hampshire which undoubtedly belongs as an individual form to *tripunctana*. This form is not yet named, but is already known in Europe. The forewings are gray, speckled with dark gray, and have a large dark-gray costal spot. This form is somewhat similar to the Scandinavian *Acleris ferrumixtana* (Benander), but has the genitalia typical of *tripunctana*. The nominate form of *tripunctana* has forewings more or less brownish ochreous with a costal spot dark brown or black. It has not yet been recorded in the Nearctic region where *tripunctana* seems to be an introduced species and may therefore have a more limited number of individual forms than in the Palearctic region, of which it is native.

SPECIMEN EXAMINED.—One male (genitalia on slide 233-Obr.), Hampton, N. H., Oct. 23, 1906 (S. A. Shaw), AMNH.

Acleris tripunctana (Hübner) form *galacteana* Krulikovskij

Teras ferrugana (in part).—Fischer von Röslerstamm, 1836, Abbildungen zur Berichtigung und Ergänzung der Schmetterlingskunde, p. 40, pl. 25, fig. 1c.

Acalla ferrugana aberration *galacteana* Krulikovskij, 1903, Rev. Russe Ent., vol. 3, p. 180.

Acalla ferrugana var. *tripunctana* (in part).—Kennel, 1908, Die palaearktischen Tortriciden, pl. 5, fig. 43.

Peronea ferrugana.—McDunnough, 1943, Canadian Journ. Res., vol. 11, p. 321.

Acleris tripunctana aberration *galacteana*.—Obraztsov, 1956, Tijdschr. Ent., vol. 99, p. 132.

As noted above in the section on *tripunctana*, this individual form is known in the Nearctic region from Canada as one male from the Ottawa district and one female from Salt River, Northwest Territories (McDunnough, 1934).

TYPE.—Holotype, Urzhum, Kirov (Viatka) territory, Russia, in the Zoological Museum of the State University of Kiev.

Acleris cervinana (Fernald)

Teras cervinana Fernald, 1882, Trans. Amer. Ent. Soc., vol. 10, p. 65.—Grote, 1882, New check list of North American moths, p. 57, no. 28.

Alceris [sic] *cervinana*.—Fernald, [1903], U.S. Nat. Mus. Bull. 52, p. 475, no. 5323, 1902.

Peronea cervinana.—Meyrick, 1912, *in* Wagner, Lepidopterorum catalogus, pt. 10, p. 61; 1913, *in* Wytsman, Genera insectorum, fasc. 149, p. 62.—Barnes and McDunnough, 1917, Check list of the Lepidoptera of Boreal America, p. 178, no. 7416.—Barnes and Busck, 1920, Contr. Nat. Hist. Lep. North America, vol. 4, pl. 32, fig. 7.—Blackmore, 1921, British Columbia Prov. Mus. Rept., 1920, p. 24.—Forbes, [1924], Cornell Univ. Agr. Exp. Stat. Mem. 68, p. 483, 1923.—McDunnough, 1934, Canadian Journ. Res., vol. 11, pp. 316, p. 328 (fig. 1), 332 (fig. 2); 1939, Mem. Southern California Acad. Sci., vol. 2, p. 59, no. 7505.

The nominate form of *cervinana* was described as having the forewings "reddish fawn colored, touched with white along the costa." It has a dark brown costal spot with a white center, reaching to the middle of discal cell, and some tufts of dark brown raised scales in the discal cell, on the fold near the base of forewing and above this fold, and in the external part of forewing, where these tufts are arranged in an oblique line. In the form *americana* (see below!) the forewings should be "white, dimly reticulated with light red which is suffused along the borders." The costal spot of *americana* is dark red, composed of three parts touching each other. Two red lines originate from this spot, and run across the forewing. The tufts of black scales on the fold of forewings and over it, are similar to those of the nominate form of *cervinana*.

The present author saw only some few specimens corresponding completely to the diagnoses of the nominate form *cervinana* and form *americana*. Until a complete revision of the variation of this species is done, it seems reasonable to indicate all specimens with reticulation of forewings as form *americana*, to ignore the remaining characters of this form, and to treat all specimens without reticulation as form *cervinana*. Some specimens of these two forms have a solid costal spot; others have it formed by an arch or composed of three parts. The color of this spot varies from pale brown or gray to reddish, dark brown, or black. The lines originating from this spot may be well developed or lacking; sometimes only one of them is lacking, or one may be reduced in its lower part. The ground color of forewings varies from whitish gray or pale ochreous to gray and reddish brown; in some specimens the light ground is slightly touched with some of the above colors. In the form *americana*, the color of reticulation varies from pale brown to chestnut brown or almost black. McDunnough (1934) mentioned a specimen which cannot be identified with the nominate form of *cervinana* or with form *americana*.

The basal third of the forewing in this specimen is white, and the remainder is deep purple brown. The present author saw a female of this form from Wellington, British Columbia (May 15, G. W. Taylor; genitalia on slide 459-Obr.; AMNH), and another female from Hampton, N.H. (Mar. 31, 1905, S. A. Shaw; in the same collection), the latter with a well-developed dark-brown reticulation as in the form *americana*. This bicolored form is somewhat similar to "form a" of *britannia*, described in the present paper, and a form of *braunana*, mentioned by McDunnough (1934, p. 318).

FOOD PLANT.—As stated on the label on a female from Orono, Maine (Sept. 19, 1882; genitalia on slide, prepared by A. Busck, Dec. 12, 1924; in USNM), the food plant of *cervinana* is alder.

TYPE.—Lectotype (selected by the present author), male (genitalia on slide, prepared by A. Busck, Apr. 20, 1925), Cambridge (or ?Beverly), Mass., USNM.

Acleris cervinana (Fernald) form *americana* Fernald

Teras americana Fernald, 1882, Trans. Amer. Ent. Soc., vol. 10, p. 66.—Grote, 1882, New check list of North American moths, p. 57, no. 29.—Moffat, 1887, Canadian Ent., vol. 19, p. 88.

Alceris (sic) *americana*.—Fernald, [1903], U.S. Nat. Mus. Bull. 52, p. 475, no. 5324, 1902.

Peronea americana.—Meyrick, 1912, *in* Wagner, Lepidopterorum catalogus, pt. 10, p. 62; 1913, *in* Wytsman, Genera insectorum, fasc. 149, p. 63.—Barnes and McDunnough, 1917, Check list of the Lepidoptera of Boreal America, p. 178, no. 7421.—Forbes, [1924], Cornell Univ. Agr. Exp. Stat. Mem. 68, p. 484, 1923.

Peronea cervinana (in part).—McDunnough, 1934, Canadian Journ. Res., vol. 11, p. 316.

Peronea cervinana form *americana*.—McDunnough, 1939, Mem. Southern California Acad. Sci., vol. 2, p. 59, no. 7505.

TYPE.—Lectotype (selected by the present author) male, Cambridge (or ?Beverly), Mass., USNM.

Acleris santacrucis, new species

PLATES 2 (FIG. 4), 9 (FIG. 29), 10 (FIGS. 32, 33)

Antennae, head, and thorax brownish ochreous. Labial palpi concolorous with the above, but much paler from inside. Forewings with costa slightly excavate before somewhat produced apex; termen slightly concave below apex. Ground of forewings ochreous with silky gloss; entire surface with brownish-ochreous reticulation consisting of numerous fine, chiefly transverse lines. Basal area (less than a quarter of wing length) separated by slightly darker brownish-ochreous fine convex line with minute groups of brownish-black raised scales on it. At about middle of costa, an elongate brownish spot oblique externad, reaching to below upper edge of discal cell and connected there to another similar costal spot situated externad and

oblique in opposite direction, the two spots forming a kind of triangle. From this connection, a rather broad brownish-ochreous fascia originates which reaches dorsum before tornus and is paler than the costal spots. Margins of both costal spots and fascia finely outlined by darker lines with small groups of brownish-black scales on them. A fine short brownish line at costa before wing apex, oblique basad. Two fine brownish-ochreous transverse lines between middle fascia and termen, hardly separable from lines of ground reticulation. Terminal line brown. Cilia ochreous. Reverse of forewings whitish ochreous; costa with traces of markings of upper surface, and fine short grayish lines; apex outlined by a brown terminal line. Length of forewing, 7–7.5 mm. Hind wings silky white, slightly yellowish at apex and cilia; in female with slight brownish-gray reticulation before apex and termen.

MALE GENITALIA.—Similar to those of *cervinana*, but with aedoeagus somewhat thicker and its preapical thorn strongly curved caudad; three cornuti, more stout than in *cervinana*.

FEMALE GENITALIA.—Sterigma with lateral lobes broad and stout. Antrum well developed, subcylindrical, slightly narrowed caudad. Ductus bursae slightly sclerotized laterocaudad, then narrowed before a wide sack forming its cephalic portion. Signum stellate, scobinate.

TYPES.—Holotype, male (genitalia on slide, prepared by A. Busck, Feb. 10, 1933), Santa Cruz, Calif., Oct. 29, 1932 (Tilden); allotype, female (genitalia on slide 1–Obr., Jan. 28, 1959), taken together with holotype. Types in USNM (no. 65586).

REMARKS.—Externally this species may remind one of *Acleris rhombana* (Schiffermiller and Denis), but it has a different wing shape and completely dissimilar genitalia. Those of the male of the new species are very close to the genitalia of *A. cervinana* (Fernald), but differ as mentioned above. In the female, the lateral lobes of the sterigma are broader than in *cervinana;* the antrum does not form any curvation of caudal angles; the sack of the ductus bursae is not narrowed caudad. From *A. subnivana* (Walker), which the new species resembles in having a sinuate costa of the forewings but no likeness in their markings, it differs by much longer cornuti and entirely distinct shapes of the sterigma and antrum.

Acleris comandrana (Fernald)

FIGURE 3

Teras comandrana Fernald, 1892, Canadian Ent., vol. 24, p. 121.

Alceris [sic] *comandrana.*—Fernald, [1903], U.S. Nat. Mus. Bull. 52, p. 475, no. 5326, 1902.

Peronea comandrana.—Meyrick, 1912, *in* Wagner, Lepidopterorum catalogus, pt. 10, p. 61; 1913, *in* Wytsman, Genera insectorum, fasc. 149, p. 62.—Barnes and McDunnough, 1917, Check list of the Lepidoptera of Boreal

America, p. 178, no. 7417.—Forbes, [1924], Cornell Univ. Agr. Exp. Stat. Mem. 68, p. 484, 1923.—McDunnough, 1939, Mem. Southern California Acad. Sci., vol. 2, p. 59, no. 7506.

As with many other *Acleris* species, a description of *comandrana* based only on external characters gives almost no chance to recognize this species. The following new data upon the genitalia are filling up this gap, although there is no complete evidence that the male genitalia really belong to this species. Although the examined males are very close externally to the female type of *comandrana*, they originate from another locality, and this circumstance leaves some doubt about the conspecificity of the two sexes.

MALE GENITALIA.—Tegumen moderate, without cristae; gnathos with a strong hoodlike ventroapical projection; socii upright, elongate reniform, not reaching the top of tegumen. Valvae moderately wide; ventral margin of sacculus gently sinuate, with an elongate terminal hair tuft; brachiola broad. Aedoeagus slightly curved, rather stout, dilated cephalad; vesica with two pairs of almost equally sized thin cornuti and with a stout coniform apical cornutus.

FEMALE GENITALIA.—Sterigma rather broad, with short acute lateral lobes. Ostium bursae remote from cephalic margin of sterigma,

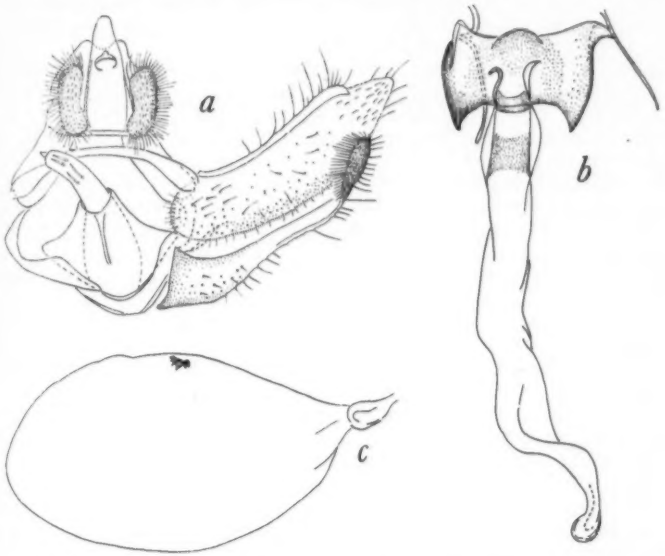

FIGURE 3.—*Acleris comandrana* (Fernald): *a*, male genitalia (Whitesbog, N.J., Oct. 30, 1916; slide prepared by A. Busck, Sept. 14, 1914; USNM); *b*, female genitalia, sterigma and ductus bursae (lectotype); *c*, corpus bursae (Pennsylvania; slide prepared by A. Busck, Sept. 10, 1924; USNM).

semicircular with caudal flaps turned cephalad. Antrum a moderate plate. Ductus bursae with a broad sclerotized girdle remote from antrum, forming together with cervix bursae a rather broad tube. Corpus bursae elongate; signum semistellate.

REMARKS.—The number of cornuti is the same as in *semiannula* or *implexana*, but instead of a sclerotized plate, a coniform apical cornutus is present. The female genitalia are rather similar to those of *implexana*, especially the shape of sterigma, but the ductus bursae have a sclerotization forming a complete girdle, and the signum is semistellate.

TYPE.—Lectotype (selected by the present author), female (genitalia on slide, prepared by A. Busck, Sept. 7, 1924), Amherst, Mass., USNM.

OTHER SPECIMENS EXAMINED.—Two males (genitalia on slides, prepared by A. Busck, Apr. 6 and Sept. 14, 1924), Whitesbog, N.J., July 7 and Oct. 30, 1916 (H. B. Scammel); one female (genitalia on slide, prepared by A. Busck, Sept. 10, 1924), Pennsylvania. All the above specimens in USNM.

FOOD PLANTS.—*Andromeda; Comandra.*

Acleris subnivana (Walker)

Penthina subnivana Walker, 1863, List of the specimens of lepidopterous insects in the British Museum, pt. 28, p. 376.

Teras deflectana Robinson, 1869, Trans. Amer. Ent. Soc., vol. 2, p. 283, pl. 7, fig. 71.—Zeller, 1875, Verhandl. zool.-bot. Ges. Wien, vol. 25, p. 211.—Klots, 1942, Bull. Amer. Mus. Nat. Hist., vol. 79, p. 413.

Rhacodia peculiana Zeller, 1875, Verhandl. zool.-bot. Ges. Wien, vol. 25, p. 210, pl. 8, fig. 1.

Teras subnivana.—Walsingham, 1879, Illustrations of typical specimens of Lepidoptera Heterocera, vol. 4, p. 1, pl. 61, fig. 2.—Fernald, 1882, Trans. Amer. Ent. Soc., vol. 10, p. 5.—Grote, 1882, New check list of North American moths, p. 57, no. 3.

Teras peculiana.—Fernald, 1882, Trans. Amer. Ent. Soc., vol. 10, p. 5.—Grote, 1882, New check list of North American moths, p. 57, no. 2.

Alceris [sic] *peculiana.*—Fernald, [1903], U.S. Nat. Mus. Bull. 52, p. 472, no. 5300, 1902.

Alceris [sic] *subnivana.*—Fernald, [1903], U.S. Nat. Mus. Bull. 52, p. 472 no. 5301, 1902.

Peronea subnivana.—Meyrick, 1912, *in* Wagner, Lepidopterorum catalogus, pt. 10, p. 69; 1913, *in* Wytsman, Genera insectorum, fasc. 149, p. 65.—Barnes and McDunnough, 1917, Check list of the Lepidoptera of Boreal America, p. 178, no. 7443.—Forbes, [1924], Cornell Univ. Agr. Exp. Stat. Mem. 68, p. 483, 1923.—McDunnough, 1934, Canadian Journ. Res., vol. 11, pp. 317, 328 (fig. 2), 332 (fig. 3); 1939, Mem. Southern California Acad. Sci., vol. 2, p. 59, no. 7507.

Peronea peculiana, Meyrick, 1912, *in* Wagner, Lepidopterorum catalogus, pt. 10, p. 70; 1913, *in* Wytsman, Genera insectorum, fasc. 149, p. 65.—Barnes and McDunnough, 1917, Check list of the Lepidoptera of Boreal America, p. 178, no. 7445.

TYPES.—Lectotype of *subnivana* (selected by the present author), male (without abdomen), Nova Scotia (Redman), BM. Lectotype of *deflectana* (selected by Klots, 1942), female, Pennsylvania, in the Academy of Natural Sciences of Philadelphia. Holotype of *peculiana*, Texas, in the Museum of Comparative Zoology.

VARIATION.—McDunnough (1934) noted in *subnivana* variation of the ground color of forewings, their reticulation in some specimens, and the triangular costal spot solid or interrupted by a pale patch. The present author can add that there are specimens of *subnivana* in which a slight pale brownish band, connecting the costal spot with the dorsum, is present. This band in two of the examined specimens is especially well developed and dark: in a female lectoparatype, without data, and a female from New Brighton, Pa., Oct. 19, 1902 (H. D. Merrick), both in AMNH. A female specimen (genitalia on slide, prepared by A. Busck, Oct. 10, 1924) from Vancouver Island (A. W. Hanham), in USNM, has pale ochreous forewings. The costal triangle is reduced to a gray minute dot representing the external part of this triangle. This dot is connected with tornus by a narrow ochreous line slightly darker than the ground. Instead of the inner part of the costal triangle, there is a pale brownish-ochreous median fascia reaching the dorsum at tornus. This fascia is very pale and almost obliterate in its lower section. The cilia of forewings are pale chestnut brown.

***Acleris braunana* (McDunnough), new combination**

Peronea ferrugana.—Barnes and Busck (not Schiffermiller and Denis), 1920, Contr. Nat. Hist. Lep. North America, vol. 4, pl. 32, fig. 2.

Peronea braunana McDunnough, 1934, Canadian Journ. Res., vol. 11, pp. 317, 328 (fig. 3), 332 (fig. 4); 1939, Mem. Southern California Acad. Sci., vol. 2, p. 59, no. 7508; 1942, Canadian Ent., vol. 74, p. 70.

Among the materials examined by the present author, there are a male specimen taken at Greenport, Long Island (Sept. 23, 1947, J. McDunnough; genitalia on slide 407–Obr.; AMNH), bred from grape, and a male specimen from Silverton, Colo. (genitalia on slide, prepared by A. Busck, May 10, 1935; USNM), bred from willow.

***Acleris kearfottana* (McDunnough), new combination**

Peronea kearfottana McDunnough, 1934, Canadian Journ. Res., vol. 11, pp. 318, 328 (fig. 4), 332 (fig. 5); 1935, Canadian Ent., vol. 67, pp. 77 and 148; 1939, Mem. Southern California Acad. Sci., vol. 2, p. 59, no. 7509; 1940, Canadian Ent., vol. 72, p. 61.

As an individual form not yet described, a female specimen from Hampton, N.H. (Apr. 26, 1908, S. A. Shaw; genitalia on slide 408–Obr.; AMNH), has to be mentioned here. The forewings are brownish gray, paler distad, with a dark costal patch and a diffuse fuscous shadow below it.

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***Acleris semiannula* (Robinson), new combination**

Teras semiannula.—Robinson, 1869, Trans. Amer. Ent, Soc., vol. 2, p. 282, pl. 7, fig. 70.—Zeller, 1875, Verhandl. zool.-bot. Ges. Wien, vol. 25, p. 212.

Teras ferrugana var. *semiannula.*—Walsingham, 1879, Illustrations of typical specimens of Lepidoptera Heterocera, pt. 4, p. 76.

Teras ferrugana.—Fernald, 1882, Trans. Amer. Ent. Soc., vol. 10, p. 8 (in part).

Alceris [sic] *ferrugana.*—Fernald, [1903], U.S. Nat. Mus. Bull. 52, p. 474, no. 5316 (in part), 1902.

Peronea ferrugana (in part).—Meyrick, 1912, *in* Wagner, Lepidopterorum catalogus, pt. 10, p. 60; 1913, *in* Wytsman, Genera insectorum, fasc. 149, p. 62.—Barnes and McDunnough, 1917, Check list of the Lepidoptera of Boreal America, p. 178, no. 7413.

Peronea stadiana Barnes and Busck, 1920, Contr. Nat. Hist. Lep. North America, vol. 4, p. 217.

Peronea ferrugana form *semiannula.*—Forbes, [1924], Cornell Univ. Agr. Exp. Stat. Mem. 68, p. 487, 1923.

Peronea semiannula.—McDunnough, 1934, Canadian Journ. Res., vol. 11, pp. 322, 328 (fig. 8), 332 (fig. 9); 1935, Canadian Ent., vol. 67, p. 148; 1939, Mem. Southern California Acad. Sci., vol. 2, p. 59, no. 7514.

TYPES.—Holotype of *semiannula*, female, Pennsylvania, in the Academy of Natural Sciences of Philadelphia. Holotype of *stadiana*, male, Ottawa, Ontario, Sept. 18, 1905 (C. H. Young), USNM.

REMARKS.—As one of the characters of this species, McDunnough (1934) mentioned the presence of a pair of apical cornuti and of two more cornuti with a chitinous plate between them in the central part of vesica. In most of the examined specimens of *semiannula*, the present author observed the same, although the position of the plate was not always as above, but was sometimes at one side of two central cornuti. In one male specimen from Montclair, N.J. (Nov. 2, 1903, W. D. Kearfott; genitalia on slide 224–Obr.; AMNH), only one cornutus of the central group is present, but the remaining armature of the vesica is normal. There is a male specimen from New York (Big Indian Valley, Catskill Mountains, July 10, 1906, R. F. Pearsall; genitalia on slide 234–Obr.; AMNH) in which the number of cornuti is normal, but one cornutus in the central group is thinner and somewhat shorter than the other. This specimen has broad brownish-ochreous forewings, much more intensively colored than usual in *semiannula*. The markings of the forewings are also somewhat different, and there are some doubts about the systematic position of this specimen. Two males and two females from Essex County, N.J. (May, W. D. Kearfott; genitalia on slides 222–Obr., 223–Obr., and 231–Obr.; AMNH), reared from *Betula alba*, have forewings colored similarly to those of the specimen from New York. The forewings are shorter and relatively broader than in the common form of *semiannula*, but the genitalia do not differ in any way from those of this species. Should it be confirmed that the food plant of

semiannula is maple (McDunnough, 1934) and that the moths reared from this plant always have elongate forewings, the short-winged form from birch might receive a separate name.

***Acleris implexana* (Walker), new combination**

PLATE 10 (FIG. 34)

Sciaphila implexana Walker, 1863, List of the specimens of lepidopterous insects in the British Museum, pt. 28, p. 338.

Acleris heindelana Fernald, 1905, Amer. Nat., vol. 39, p. 870. New synonym.

Peronea heindelana.—Meyrick, 1912, *in* Wagner, Lepidopterorum catalogus, pt. 10, p. 64; 1913, *in* Wytsman, Genera insectorum, fasc. 149, p. 63.—Barnes and McDunnough, 1917, Check list of the Lepidoptera of Boreal America, p. 178, no. 7429.

Peronea heindeliana [sic].—Forbes, [1924], Cornell Univ. Agr. Exp. Stat. Mem. 68, p. 483, 1923.

Peronea gallicolana form *heindelana.*—McDunnough, 1934, Canadian Journ. Res., vol. 11, p. 323; 1939, Mem. Southern California Acad. Sci., vol. 2, p. 59, no. 7515.

Peronea hudsoniana (in part).—McDunnough, 1934, Canadian Journ. Res., vol. 11, p. 312; 1939, Mem. Southern California Acad. Sci., vol. 2, p. 59, no. 7500.

A genitalia examination of the type specimen of "*Sciaphila*" *implexana* in the British Museum showed definitely that this species has nothing in common with *A. hudsoniana* (Walker) with which McDunnough (1934) placed it as a synonym. There is no doubt that *implexana* is the same species which McDunnough called *gallicolana*.

McDunnough treated *heindelana* as a form of *gallicolana* Clemens. The female lectotype of *heindelana* in the United States National Museum corresponds well to the type of *implexana*. Unfortunately, no indubitable proof of what the true *gallicolana* is can be cited, because the type specimen lacks an abdomen. A specimen in Fernald's collection (USNM), labeled "*Teras gallicolana* Cl. Comp[are]d with Rob[in]-s[on] type," might seem to disaffirm McDunnough's conception of this species. The genitalia of this specimen correspond to those of the species described by McDunnough as *braunana*. There is, however, no reason to give any preference to Fernald's identification of *gallicolana* over McDunnough's conception of this species. Fernald based his "homotype" on its superficial similarity to the type of *gallicolana;* McDunnough came to his conclusion on the basis of the original description of this species. Both authors might be equally right or mistaken, because they did not compare the genitalia of their specimens with those of the type of *gallicolana*. But, because this comparison cannot be done and there are no other ways to prove the identity of the type of *gallicolana*, the present author is inclined to follow McDunnough's conception of this species, the more so because

McDunnough published his point of view and Fernald did not. Inasmuch as *implexana* (=*heindelana*) is the nominate form of the species, *gallicolana* must be treated as its individual form.

TYPES.—Holotype of *implexana*, female (genitalia on slide 5355), St. Martins Falls, Albany River, Hudsons Bay, Canada, 1844 (Barnston), BM. Lectotype of *heindelana* (selected by the present author), female (genitalia on slide, prepared by A. Busck, May 22, 1924), Winnipeg, Manitoba (A. W. Hanham), USNM.

***Acleris implexana* (Walker) form *gallicolana* Clemens, new status**

Peronea gallicolana Clemens, 1864, Proc. Ent. Soc. Philadelphia vol. 3, p. 516.—McDunnough, 1934, Canadian Journ. Res., vol. 11, pp. 323, 328 (fig. 9), 332 (fig. 10); 1939, Mem. Southern California Acad. Sci., vol. 2, p. 59, no. 7515; 1942, Canadian Ent., vol. 74, p. 70—Darlington, 1947, Trans. Amer. Ent. Soc., vol. 73, p. 103.

Teras gallicolana.—Walker, 1866, List of the specimens of lepidopterous insects in the British Museum, pt. 35, p. 1779.

Teras ferrugana (in part).—Fernald, 1882, Trans. Amer. Ent. Soc., vol. 10, p. 8.

Alceris [sic] *ferrugana* (in part).—Fernald, [1903], U.S. Nat. Mus. Bull. 52, p. 474, no. 5316, 1902.

Peronea ferrugana (in part).—Meyrick, 1912, *in* Wagner, Lepidopterorum catalogus pt. 10, p. 61; 1913, *in* Wytsman, Genera insectorum, fasc. 149, p. 62.—Barnes and McDunnough, 1917, Check list of the Lepidoptera of Boreal America, p. 178, no. 7413.

TYPE.—Lectotype (selected by Darlington, 1947), male (without abdomen), no data, in the Academy of Natural Sciences of Philadelphia.

***Acleris schalleriana viburnana* (Clemens)**

Peronea viburnana Clemens, 1860, Proc. Acad. Nat. Sci. Philadelphia, p. 347.—Darlington, 1947, Trans. Amer. Ent. Soc., vol. 73, p. 103.

Teras viburnana.—Walker, 1864, List of the specimens of lepidopterous insects in the British Museum, pt. 30, p. 983.—Robinson, 1869, Trans. Amer. Ent. Soc., vol. 2, p. 281, pl. 7, fig. 66.—Zeller, 1875, Verhandl. zool.-bot. Ges. Wien, vol. 25, p. 214.

Teras logiana (in part).—Fernald, 1882, Trans. Amer. Ent. Soc., vol. 10, p. 7.—Grote, 1882, New check list of North American moths, p. 57, no. 14.

Teras logiana var. *viburnana*, Fernald, 1882, Trans. Amer. Ent. Soc., vol. 10, p. 8.—Grote, 1882, New check list of North American moths, p. 57, no. 14.

Alceris [sic] *logiana* (in part).—Fernald, [1903], U.S. Nat. Mus. Bull. 52, p. 474, no. 5312, 1902.

Alceris [sic] *logiana viburnana*.—Fernald, [1903], U.S. Nat. Mus. Bull. 52, p. 474, no. 5312a, 1902.

Peronea logiana (in part).—Meyrick, 1912, *in* Wagner, Lepidopterorum catalogus, pt. 10, p. 65; 1913, *in* Wytsman, Genera insectorum, fasc. 149, p. 64.—Barnes and McDunnough, 1917, Check list of the Lepidoptera of Boreal America, p. 178, no. 7423.—Forbes, [1924], Cornell Univ. Agr. Exp. Stat. Mem. 68, p. 485, 1923.

Peronea logiana var. (or form) *viburnana*.—Mosher, 1916, Bull. Illinois State Lab. Nat. Hist., vol. 12, p. 57.—Barnes and McDunnough, 1917, Check list of the Lepidoptera of Boreal America, p. 178, no. 7423.

Peronea schalleriana.—McDunnough (not Linné), 1934, Canadian Journ. Res., vol. 11, pp. 297, 325 (fig. 9), 329 (fig. 9); 1939, Mem. Southern California Acad. Sci., vol. 2, p. 58, no. 7479.

Acleris schalleriana aberration *viburnana* (in part).—Obraztsov, 1956, Tijdschr. Ent., vol. 99, p. 134.

McDunnough (1934) found that the North American specimens of *schalleriana* do not differ in any marked respect from the European forms of this species, the variation of which is shown in Kennel's (1908, pl. 4, figs. 34–38) figures. A large series of moths of this species from North America, examined by the present author and compared with the European specimens, has distinctly shown that the variation of *schalleriana* is quite distinct in both parts of the Holarctic region, and the Nearctic population deserves a separation as a subspecies. The form *viburnana*, which is predominant in North America, although it reminds one somewhat of the European form *falsana* Hübner (*germarana* Frölich), differs from it in having the forewings more elongate, with the ground color from pearl gray to deep grayish ochreous and markings darker. Especially typical of *viburnana* is the tendency of the costal spot of forewings to divide and form a separate middle fascia and a comparatively small outer part of costal spot between this fascia and the wing apex. This small fragment of the costal spot is usually connected with the tornus by a fine line. In the true *falsana*, not yet known from North America, the middle fascia can be observed rather as an exception, although it is common in the form *plumbosana* Haworth, known from both Europe and North America. In this latter form, synonymous with *famula* Zeller, the forewings are more rotundate, more or less shaded with yellowish externad. The North American specimens of *schalleriana* forewings darkened and markings indistinct, might be identified with the form *castaneana* Haworth, although there is some difference between them and the European specimens of this form. The latter have no markings at all because the markings of the European specimens of *schalleriana* are considerably paler than those of the North American *viburnana*, and they are thus not seen on a dark ground.

Type.—Lectotype of *viburnana* (selected by Darlington, 1947), female (without abdomen), "131" (7254, type), in the Academy of Natural Sciences of Philadelphia.

Other specimens examined.—One female (genitalia on slide 545–Obr.), Maxton, N.C., Nov. 29, 1943 (A. B. Klots), AMNH. One male and one female (genitalia on slides, prepared by A. Busck, Oct. 20 and Nov. 11, 1923), Hyattsville, Md., Sept. 30, 1907 (A. Busck); one female (genitalia on slide, prepared by A. Busck, May 8, 1935), Whitesbog, N.J., Jan. 2, 1914 (H. B. Scammel); USNM. One

female (genitalia on slide 232-Obr.), Hampton, N.H., Apr. 10, 1909 (S. A. Shaw), AMNH. Many other specimens from New Jersey, Pennsylvania, and New Hampshire.

***Acleris schalleriana viburnana* (Clemens) form *castaneana* Haworth**

Tortrix castaneana Haworth, 1811, Lepidoptera Britannica, p. 410.

Peronea plumbosana.—Wood (not Haworth), 1839, Index entomologicus, p. 158, pl. 36, fig. 1082.

Peronea plumbana [sic].—Westwood and Humphreys, 1845, British moths and their transformations, vol. 2, p. 160, pl. 95, fig 4.

Teras violaceana Guenée, 1845, Ann. Soc. Ent. France, ser. 2, vol. 3, p. 146; [1846], Europaeorum Microlepidopterorum index methodicus, p. 12, 1845.—Bruand, 1847, Men. Soc. Émul. Doubs, Catalogue des microlépidoptères . . . Doubs, p. 35.— de Joannis, 1919, Ann. Soc. Ent. France, vol. 88, p. 5.

Peronea (*Acleris*) *plumbosana* (in part).—Stephens, 1852, List of the specimens of British animals in the British Museum, pt. 10, p. 19.

Teras tristana (in part).—Walker, 1863, List of the specimens of lepidopterous insects in the British Museum, pt. 27, p. 208.

Teras mixtana (in part).—Walker, 1863, List of the specimens of lepidopterous insects in the British Museum, pt. 27, p. 208.

Acalla mixtana (in part).—Rebel, 1901, *in* Staudinger and Rebel, Catalog der Lepidopteren des palaearctischen Faunengebietes, vol. 2, p. 81, no. 1451.

Peronea logiana (in part).—Barrett, 1905, Lepidoptera of the British Islands, vol. 10, p. 228.—Meyrick, 1912, *in* Wagner, Lepidopterorum catalogus, pt. 10, p. 65; 1913, *in* Wytsman, Genera insectorum, fasc. 149, p. 64.

Peronea logiana var.—Barrett, 1905, Lepidoptera of the British Islands, vol. 10, pl. 453, fig. 3.

Acalla logiana form *germarana* (in part).—Kennel, 1908, Die palaearktischen Tortriciden, p. 78.

Acalla logiana aberration *plumbosana* Kennel, 1908, Die palaeartischen Tortriciden, pl. 4, fig. 38.

Peronea mixtana (in part).—Meyrick, 1912, *in* Wagner, Lepidopterorum catalogus, pt. 10, p. 65; 1913, *in* Wytsman, Genera insectorum, fasc. 149, p. 64.

Peronea logiana variety *famula*.—Forbes (not Zeller), [1924], Cornell Univ. Agr. Exp. Stat. Mem. 68, p. 485, 1923.

Peronea schalleriana form *castaneana*.—Sheldon, 1930, The Ent., vol. 63, p. 198.

Acleris schalleriana aberration *castaneana*.—Obraztsov, 1956, Tijdschr. Ent., vol. 99, p. 134.

TYPES.—Type of *castaneana* (cf. Sheldon, 1930), England, BM. Type of *violaceana* (cf. Joannis, 1919), in the Museum National d'Histoire Naturelle (Paris).

SPECIMENS EXAMINED.—One male (genitalia on slide 182–Obr.), Montclair, N.J., Nov. 2, 1903 (W. D. Kearfott); one male (genitalia on slide 578-Obr.), Oak Station, Allegheny County, Penn., Nov. 21,1905 (F. Marloff); one male (genitalia on slide 240-Obr.), Hampton, N.H., June 27, 1908 (S. A. Shaw); one male (genitalia on slide 440-Obr.), Framingham, Mass., Oct. 8, 1905; AMNH. Many other specimens from the above states and North Carolina.

***Acleris schalleriana viburnana* (Clemens) form *plumbosana* Haworth**

Tortrix plumbosana Haworth, 1811, Lepidoptera Britannica, p. 415.

Peronea plumbosana.—Curtis, 1824, British entomology, expl. pl. 16.—Stephens, 1829, Systematic catalogue of British insects, vol. 2, p. 186, no. 7079; 1834, Illustrations of British entomology, Haustellata, vol. 4, p. 158.

Teras logiana (in part).—Treitschke, 1830, Schmetterlinge von Europa, vol. 8, p. 262.

Peronea boscana.—Wood (not Fabricius), 1839, Index entomologicus, p. 158, pl. 36, fig. 1083.

Teras erutana Herrich-Schäffer, 1847, Systematische Bearbeitung der Schmetterlinge von Europa, vol. 4, Tortricides, p. 2, fig. 9; 1851, Systematische Bearbeitung der Schmetterlinge von Europa, vol. 4, p. 143.

Peronea (Acleris) plumbosana.—Stephens, 1852, List of the specimens of British animals in the British Museum, pt. 10, p. 19.

Peronea (Acleris) boscana.—Stephens, 1853, List of the specimens of British animals in the British Museum, pt. 10, p. 19 (in part).

Teras rufana (in part).—Walker, 1863, List of the specimens of lepidopterous insects in the British Museum, pt. 27, p. 211.

Teras logiana aberration *plumbosana.*—Wocke, 1871, *in* Staudinger and Wocke, Catalog der Lepidopteren des europäischen Faunengebiets, p. 233, no. 657b.

Teras tristana (in part).—Zeller, 1875, Verhandl. zool.-bot. Ges. Wien, vol. 25, p. 214.

Teras tristana var. *famula* Zeller, 1875, Verhandl. zool.-bot. Ges. Wien, vol. 25, p. 214.—Walsingham, 1879, Illustrations of typical specimens of Lepidoptera Heterocera, pt. 4, p. 76.

Teras logiana var. *famula.*—Fernald, 1882, Trans. Amer. Ent. Soc., vol. 10, p. 8.—Grote, 1882, New check list of North American moths, p. 57, no. 14.

Acalla logiana aberration (or form) *germarana* (in part).—Rebel, 1901, *in* Staudinger and Rebel, Catalog der Lepidopteren des palaearctischen Faunengebietes, vol. 2, p. 81, no. 1452a.—Kennel, 1908, Die palaearktischen Tortriciden, pl. 4, figs. 36, 37.

Alceris [sic] *logiana famula.*—Fernald, [1903], U.S. Nat. Mus. Bull. 52, p. 474, no. 5312b, 1902.

Peronea logiana (in part).—Barrett, 1905, Lepidoptera of the British Islands, vol. 10, p. 228.—Meyrick, 1912, *in* Wagner, Lepidopterorum catalogus, pt. 10, p. 65; 1913, *in* Wytsman, Genera insectorum, fasc. 149, p. 64.

Peronea logiana var.—Barrett, 1905, Lepidoptera of the British Islands, vol. 10, pl. 453, fig. 3a.

Peronea logiana famula.—Barnes and McDunnough, 1917, Check list of the Lepidoptera of Boreal America, p. 178, no. 7423.

Peronea logiana variety *viburnana.*—Forbes (not Clemens), [1924], Cornell Univ. Agr. Exp. Stat. Mem. 68, p. 485, 1923.

Peronea schalleriana form *plumbosana.*—Sheldon, 1930, The Ent., vol. 63, p. 198.

Peronea schalleriana (in part).—McDunnough, 1934, Canadian Journ. Res., vol. 11, p. 297; 1939, Mem. Southern California Acad. Sci., vol. 2, p. 58, no. 7479.

Acleris schalleriana abberation *plumbosana.*—Obraztsov, 1956, Tijdschr. Ent., vol. 99, p. 134.

Acleris schalleriana aberration *famula.*—Obraztsov, 1956, Tijdschr. Ent., vol. 99, p. 134.

Acleris schalleriana aberration *erutana.*—Obraztsov, 1956, Tijdschr. Ent. vol. 99, p. 134.

Acleris schalleriana aberration *viburnana* (in part).—Obraztsov, 1956, Tijdschr. Ent. vol. 99, p. 134.

TYPES.—Type of *plumbosana* (cf. Sheldon, 1930), England, BM. Location of the type specimen of *erutana* is unknown. Lectotype of *famula* (selected by the present author), female (genitalia on slide, prepared by A. Busck, Dec. 6, 1929), no data, USNM.

SPECIMENS EXAMINED.—Many reared specimens in AMNH, probably from New Jersey.

Acleris variegana (Schiffermiller and Denis)

Phalaena (*Tortrix*) *variegana* Schiffermiller and Denis, 1775, Ankündigung eines systematischen Werkes von den Schmetterlingen der Wiener Gegend, p. 130; 1776, Systematisches Verzeichniss der Schmetterlinge der Wiener Gegend, p. 130.—Gmelin, 1788, Systema naturae, ed. 13, vol. 1, pt. 5, p. 2512.—Villers, 1789, Caroli Linnaei entomologia . . ., vol. 4, p. 523.—Illiger, 1801, Systematisches Verzeichniss von den Schmetterlingen der Wiener Gegend, vol. 2, p. 60.

Pyralis variegana.—Fabricius, 1787, Mantissa insectorum, vol. 2, p. 228; 1794, Entomologia systematica, vol. 3, pt. 2, p. 254.

Pyralis abildgaardana Fabricius, 1794, Entomologia systematica, vol. 3, pt. 2, p. 274.—Zincken, 1821, *in* Charpentier, Die Zinsler, Wickler, Schaben und Geistchen des Systematischen Verzeichnisses der Schmetterlinge der Wiener Gegend, p. 60.

Cristana.—Hübner (not Schiffermiller and Denis), 1796–1799, Sammlung europäischer Schmetterlinge, Tortrices, pl. 10, fig. 55. (uninominal).

Phalaena (*Tortrix*) *cristana*.—Illiger, 1801, Systematisches Verzeichniss von den Schmetterlingen der Wiener Gegend, vol 2, p. 57.

Tortrix variegana.—Laspeyres, 1805, Illiger's Mag. Insektenkunde, vol. 4, p. 13.—Haworth, 1811, Lepidoptera Britannica, p. 414.—Charpentier, 1821, Die Zinsler, Wickler, Schaben und Geistchen des Systematischen Verzeichnisses der Schmetterlinge der Wiener Gegend, p. 70.—Werneburg, 1864, Beiträge zur Schmetterlingskunde, vol. 2, p. 201.

Tortrix blandiana Charpentier, 1821, Die Zinsler, Wickler, Schaben und Geistchen des Systematischen Verzeichnisses der Schmetterlinge der Wiener Gegend, p. 98.

Eutrachia cristana.—Hübner, 1822, Systematisch-alphabetisches Verzeichniss, p. 60.

Eclectis blandana Hübner, 1825, Verzeichniss bekannter Schmettlinge [sic], p. 385.

Tortrix abildgaardana.—Frölich, 1828, Enumeratio Tortricum Würtembergiae, p. 19.

Teras abildgaardana.—Treitschke, 1829, Schmetterlinge von Europa, vol. 7, p. 229; 1830, Schmetterlinge von Europa, vol. 8, p. 268; 1835, Schmetterlinge von Europa, vol. 10, pt. 3, pp. 137 and 262.—Guenée, 1845, Ann. Soc. Ent. France, ser. 2, vol. 3, p. 144; [1846], Europaeorum Microlepidopterorum index methodicus, p. 10, 1845.—Zeller, 1847, Isis, p. 739.—Lederer, 1859, Wiener Ent. Monatschr., vol. 3, p. 152.

Peronea variegana.—Stephens, 1829, Systematic catalogue of British insects in the British museum, vol. 2, p. 187, no. 7087.—Curtis, post 1834, British entomology, expl. pl. 16, p. 7.—Wood, 1839, Index entomologicus, p. 159, pl. 36, fig. 1089.—Duponchel, 1845, Catalogue méthodique des lépidoptères d'Europe, p. 291.—Westwood and Humphreys, 1845, British moths and

their transformations, vol. 2, p. 161, pl. 95, fig. 13.—Wilkinson, 1859, British tortrices, p. 175.—Barrett, 1905, Lepidoptera of the British Islands, vol. 10, p. 232, pl. 454, fig. 2.—Meyrick, 1912, *in* Wagner, Lepidopterorum catalogus, pt. 10, p. 63; 1913, *in* Wytsman, Genera insectorum, fasc. 149, p. 63, pl. 5, fig. 68; 1927, Revised handbook of British Lepidoptera, pp. 519, 524.—Pierce and Metcalfe, 1922, Genitalia of the group Tortricidae, p. 23, pl. 9.—Blackmore, 1923, British Columbia Prov. Mus. Rept. for 1922, p. 27; p. 34, pl. 6—Forbes, [1924], Cornell Univ. Agr. Exp. Stat. Mem. 68, p. 484, 1923.—Sheldon, 1931, The Ent., vol. 64, p. 2.—McDunnough, 1935, Canadian Ent., vol. 67, p. 148; 1939, Mem. Southern California Acad, Sci., vol. 2, p. 58, no. 7489.—Lhomme, 1939, Catalogue des lépidoptères de France et de Belgique, vol. 2, p. 293.—Benander, 1950, Svensk Insektfauna, pt. 10, p. 17, pl. 1, fig. 14.

Peronea (*Acleris*) *variegana*.—Stephens, 1834, Illustrations of British entomology, Haustellata, vol. 4, p. 160; 1852, List of the specimens of British animals, pt. 10, p. 18.

Peronea abildgaardana—Duponchel, 1835, Histoire naturelle des lépidoptères ou papillons de France, vol. 9, p. 159, pl. 244, fig. 4.

Tortrix (*Teras*) *abildgaardana*.—Herrich-Schäffer, 1851, Systematische Bearbeitung der Schmetterlinge von Europa, vol. 4, p. 141.

Teras variegana.—Wocke, 1861, *in* Staudinger and Wocke, Catalog der Lepidopteren Europa's, p. 94, no. 563.—Walker, 1863, List of the specimens of lepidopterous insects in the British Museum, pt. 27, p. 209.—Heinemann, 1863, Schmetterlinge Deutschlands und der Schweiz, Abth. 2, vol. 1, pt. 1, p. 20.—Wocke, 1871, *in* Staudinger and Wocke, Catalog der Lepidopteren des europäischen Faunengebiets, p. 233, no. 660.—Millière, 1874, Mém. Soc. Sci. Nat. Cannes, vol. 4, p. 69.—Snellen, 1882, Vlinders van Nederland, Microlepidoptera, p. 175.—Sorhagen, 1886, Kleinschmetterlinge der Mark Brandenburg, p. 64.

Acalla variegana.—Meyrick, 1895, Handbook of British Lepidoptera, p. 523.—Rebel, 1901, *in* Staudinger and Rebel, Catalog der Lepidopteren des palaearctischen Faunengebietes, vol. 2, p. 81, no. 1455.—Kennel, 1907, *in* Spuler, Schmetterlinge Europas, vol. 2, p. 243, pl. 83, fig. 14; 1908, Die palaearktischen Tortriciden, p. 85, pl. 5, figs. 11–13.

Acleris variegana.—Obraztsov, 1956, Tijdschr. Ent., vol. 99, p. 135.—Bradley, 1956, Ent. Gaz., vol. 7, p. 154, pl. 8.—Swatschek, 1958, Larvalsystematik der Wickler, p. 76.

SPECIMENS EXAMINED.—One male and one female (genitalia on slides, prepared by A. Busck, Nov. 15, 1922, and Feb. 4, 1924), Victoria, British Columbia, Sept. 8 and 12, 1922 (E. H. Blackmore), and many other specimens from the same locality; USNM.

Acleris variegana (Schiffermiller and Denis) form *asperana* Fabricius

Pyralis asperana Fabricius, 1776, Genera insectorum, p. 292; 1781, Species insectorum, vol. 2, p. 284; 1787, Mantissa insectorum, vol. 2, p. 234; 1794. Entomologia systematica, vol. 3, pt. 2, p. 269.

Tortrix osbeckiana Thunberg and Borgstroem, 1784, Dissertationes entomologicae, vol. 1, p. 19, pl. 3, fig. 21; 1801, Dissertationes academicae, vol. 3, p. 31, pl. 3, fig. 21.

Phalaena (*Tortrix*) *asperana*.—Gmelin, 1788, Systema naturae, ed. 13, vol. 1 ,pt. 5, p. 2510.—Villers, 1789, Caroli Linnaei entomologia . . ., vol. 2, p. 409.

Phalaena (*Tortrix*) *osbeckiana*.—Gmelin, 1788, Systema naturae, ed. 13, vol. 1, pt. 5, p. 2516.

Tortrix asperana.—Haworth, 1811, Lepidoptera Britannica, p. 414.

Nyctemerana Hübner, 1814–1817, Sammlung europäischer Schmetterlinge, Tortrices, pl. 38, fig. 240 (uninominal).

Eutrachia nyctemerana.—Hübner, 1822, Systematisch-alphabetisches Verzeichniss, p. 63.

Eclectis nyctemerana.—Hübner, 1825, Verzeichniss bekannter Schmettlinge [sic], p. 385.

Tortrix variegana β.—Frölich, 1828, Enumeratio tortricum Würtembergiae, p. 20.

Peronea asperana.—Stephens, 1829, Systematic catalogue of British insects vol. 2, p. 187, no. 7086.—Curtis, post 1834, British entomology, expl. pl. 16, p. 7.—Duponchel, 1835, Histoire naturelle des lépidoptères ou papillons de France, vol. 9, p. 161, pl. 244, fig. 5.—Wood, 1839, Index entomologicus, p. 159, pl. 36, fig. 1088.—Westwood and Humphreys, 1845, British moths and their transformations, vol. 2, p. 161, pl. 95, fig. 9.

Peronea (*Acleris*) *asperana*.—Stephens, 1834, Illustrations of British entomology, Haustellata, vol. 4, p. 160; 1852, List of the specimens of British animals in the British Museum, pt. 10, p. 18.

Teras nyctemerana.—Treitschke, 1835, Schmetterlinge von Europa, vol. 10, pt. 3, p. 262.—Guenée, 1845, Ann. Soc. Ent. France, ser. 2, vol. 3, p. 144; [1846], Europaeorum Microlepidopterorum index methodicus, p. 10, 1845.

Tortrix (*Teras*) *nyctemerana*.—Herrich-Schaffer, 1851, Systematische Bearbeitung der Schmetterlinge von Europa, vol. 4, p. 142; 1856, Systematische Bearbeitung der Schmetterlinge von Europa, vol. 6, p. 155.

Peronea (*Acleris*) *osbeckiana*.—Stephens, 1852, List of the specimens of British animals in the British Museum, pt. 10, p. 18.

Peronea aspersana [sic].—Westwood (not Hübner), 1852, *in* Wood, Index entomologicus, ed. 2, p. 159, pl. 36, fig. 1088. Wilkinson, 1859, British tortrices, p. 176.

Tortrix abildgaardana.—Werneburg (not Fabricius), 1858, Stettiner Ent. Zeit., vol. 19, p. 425.

Peronea variegana (in part).—Stainton, 1859, Manual of British butterflies and moths, vol. 2, p. 234, fig.—Barrett, 1905, Lepidoptera of the British Islands, vol. 10, pl. 454, fig. 2a.—Meyrick, 1912, *in* Wagner, Lepidopterorum catalogus, pt. 10, p. 63; 1913, *in* Wytsman, Genera insectorum, fasc. 149, p. 63.

Teras variegana (in part).—Walker, 1863, List of the specimens of lepidopterous insects in the British Museum, pt. 27, p. 209.

Teras variegana aberration *asperana*.—Wocke, 1871, *in* Staudinger and Wocke, Catalog der Lepidopteren des europaeischen Faunengebiets, p. 233, no. 660a.

Acalla variegana aberration *asperana*.—Rebel, 1901, *in* Staudinger and Rebel Catalog der Lepidopteren des palaearctischen Faunengebietes, vol. 2, p. 81, no. 1455a.—Kennel, 1908, Die palaearktischen Tortriciden, p. 86, pl. 5, fig. 14.

Peronea variegana form *asperana*.—Sheldon, 1931, The Ent., vol. 64, p. 5.—Lhomme, 1939, Catalogue des lépidoptères de France et de Belgique, vol. 2, p. 294.

Peronea variegana form *nyctemerana*.—Sheldon, 1931, The Ent., vol. 64, p. 5.

Acleris variegana aberration *asperana*.—Obraztsov, 1956, Tijdschr. Ent., vol. 99, p. 135.

SPECIMENS EXAMINED.—Many specimens, Victoria, British Columbia (W. R. Carter and E. H. Blackmore); one female, Labrador; USNM. One male (genitalia on slide 446–Obr.), Berkeley, Calif., Oct. 15, 1940 (F. H. Rindge); three males (genitalia of one on slide 447–Obr.), San Mateo, Calif., June 1 and 3, 1941 (G. E. Pollard); AMNH.

***Acleris logiana placidana* (Robinson), new combination and status**

Teras placidana Robinson, 1869, Trans. Amer. Ent. Soc., vol. 2, p. 282, pl. 7, fig. 69.—Klots, 1942, Bull. Amer. Mus. Nat. Hist., vol. 79, p. 415.

Teras parisiana.—Walsingham (not Guenée), 1879, Illustrations of typical specimens of Lepidoptera Heterocera, pt. 4, p. 76.

Teras scabrana.—Fernald (not Schiffermiller and Denis), 1882, Trans. Amer. Ent. Soc., vol. 10, p. 5.—Grote, 1882, New check list of North American moths, p. 57, no. 5.

Teras niveana.—Fernald (not Fabricius), 1882, Trans. Amer. Ent. Soc., vol. 10, p. 6.—Grote, 1882, New check list of North American moths, p. 57, no. 6.

Alceris [sic] *boscana.*—Fernald (not Fabricius), [1903], U.S. Nat. Mus. Bull. 52, p. 472, no. 5303, 1902.

Alceris [sic] *boscana parisiana.*—Fernald, [1903], U.S. Nat. Mus. Bull. 52, p. 472, no. 5303a, 1902.

Alceris [sic] *niveana;* Fernald, [1903], U.S. Nat. Mus. Bull. 52, p. 472, no. 5304, 1902.

Peronea niveana (in part).—Meyrick, 1912, *in* Wagner, Lepidopterorum catalogus, pt. 10, p. 62.—Barnes and McDunnough, 1917, Check list of the Lepidoptera of Boreal America, p. 178, no. 7441.—Forbes, [1924], Cornell Univ. Agr. Exp. Stat. Mem. 68, p. 484, 1923.

Peronea boscana (in part).—Meyrick, 1912, *in* Wagner, Lepidopterorum catalogus, pt. 10, p. 62.—Barnes and McDunnough, 1917, Check list of the Lepidoptera of Boreal America, p. 178, no. 7444.

Peronea boscana parisiana.—Barnes and McDunnough, 1917, Check list of the Lepidoptera of Boreal America, p. 178, no. 7444a.

Peronea trisignana.—Forbes (not Robinson), [1924], Cornell Univ. Agr. Exp. Stat. Mem. 68, p. 483, 1923.

Peronea logiana.—McDunnough (not Clerck), 1934, Canadian Journ. Res., vol. 11, pp. 314, 327 (fig. 5), 331 (fig. 7); 1939, Mem. Southern California Acad. Sci. vol. 2, p. 59, no. 7503.

The North American population of *logiana* is distinguished by the prevalence of grayish, sometimes rather dark-colored specimens very rare in Europe. This circumstance gives reason to treat this population as a separate subspecies; however, although the name *placidana* was based on a white specimen which does not differ much from the European common form, there is no choice but to apply this name for the entire North American subspecies of *logiana*, until the gray variety receives a separate name. A form with three black dots representing fragments of a costal spot is known as form *trisignana* Robinson; *trisignana* was described also from a white specimen, and there are gray specimens too with this character.

The subspecies *placidana* and its varieties are known to the present author from the states of Washington, Idaho, Virginia, New York-New Jersey, Pennsylvania, and Maine, and in Canada from British Columbia, Alberta, Ontario, and Quebec.

TYPE.—Lectotype (selected by Klots, 1942), female, no other label data but "Type 7409"; in the Academy of Natural Sciences of Philadelphia.

***Acleris logiana placidana* (Robinson) form *trisignana* Robinson**

Teras trisignana Robinson, 1869, Trans. Amer. Ent. Soc., vol. 2, p. 282, pl. 7, fig. 69.—Fernald, 1882, Trans. Amer. Ent. Soc., vol. 10, p. 5.—Grote, 1882, New check list of North American moths, p. 57, no. 4.

Alceris [sic] *trisignana*.—Fernald, [1903], U.S. Nat. Mus. Bull. 52, p. 472, no. 5302, 1902.

Peronea niveana (in part).—Barrett, 1905, Lepidoptera of the British Islands, vol. 10, pl. 451, fig. 5a.—Benander, 1950, Svensk Insektfauna, pt. 10, pl. 1, fig. 13.

Acalla niveana var. *scotana*.—Kennel (not Stephens), 1908, Die palaearktischen Tortriciden, p. 88, pl. 5, fig. 20.

Peronea trisignana.—Meyrick, 1912, *in* Wagner, Lepidopterorum catalogus, pt. 10, p. 62; 1913, *in* Wytsman, Genera insectorum, fasc. 149, p. 63.—Barnes and McDunnough, 1917, Check list of the Lepidoptera of Boreal America, p. 178, no. 7422.

Oxigrapha logiana form *tripunctana* Sheldon, 1931, The Ent., vol. 64, p. 103.

Peronea logiana form *trisignana*.—McDunnough, 1934, Canadian Journ. Res., vol. 11, p. 315; 1939, Mem. Southern California Acad. Sci., vol. 2, p. 59, no. 7503.

Acleris logiana aberration *trisignana*.—Obraztsov, 1956, Tijdschr. Ent., vol. 99, p. 137.

TYPES.—Lectotype of *trisignana* (selected by Klots, 1942), male, West Virginia, AMNH. Type of *tripunctana*, Forres, Scotia (unknown to the present author).

***Acleris senescens* (Zeller), new combination**

PLATE 4 (FIG. 12)

Teras senescens Zeller, 1874, Verhandl. zool.-bot. Ges. Wien, vol. 24, p. 431.

Teras nigrolinea (in part).—Fernald, 1882, Trans. Amer. Ent. Soc., vol. 10, p. 6.—Grote, 1882, New check list of North American moths, p. 57, no. 7.

Alceris [sic] *nigrolinea*.—Fernald, [1903], U.S. Nat. Mus. Bull. 52, p. 473, no. 5305 (in part), 1902.

Peronea nigrolinea (in part).—Meyrick, 1912, *in* Wagner, Lepidopterorum catalogus, pt. 10, p. 66; 1913, *in* Wytsman, Genera insectorum, fasc. 149, p. 64.—Barnes and McDunnough, 1917, Check list of the Lepidoptera of Boreal America, p. 178, no. 7435.—Busck, 1931, Bull. Brooklyn Ent. Soc., vol. 26, p. 210, pl. 12, fig. 17.

Peronea senescens.—McDunnough, 1934, Canadian Journ. Res., vol. 11, pp. 300, 326 (fig. 2), 330 (fig. 2); 1939, Mem. Southern California Acad. Sci., vol. 2, p. 58, no. 7483.

TYPES.—Lectotype (selected by the present author), male, Vancouver Island, Canada: paratypes, one male ("var. B") and one female, the same data. All in BM.

REMARKS.—McDunnough (1934) wrote about the variation of this species, and noted a form with a black streak from base to apex of forewing. A male specimen from Half Moon Bay, Calif. (Feb. 6, 1940, W. H. Lange; genitalia on slide 3-Obr., Feb. 16, 1959; USNM), examined by the present author, belongs to an interesting individual form not yet described and corresponding to the form *psorana* Frölich of *Acleris scabrana* (Schiffermiller and Denis) of the Palearctic fauna. The forewings of this form of *senescens* are pale gray, with a pale pinkish-brown discal cell. Instead of a broad middle fascia, an incomplete black zigzag line is present. A fine black ray runs along the lower edge of discal cell, from the base of forewing to slightly below the apex, and becomes obliterate behind the discal cell. A fine short black line, parallel to this ray and above it, is present in the apical part of the forewing. Another black line, along the anal vein, reaches slightly beyond the transverse zigzag line.

***Acleris hastiana* (Linné)**

Phalaena Tortrix hastiana Linné, 1758, Systema naturae, ed. 10, p. 532; 1761, Fauna Suecica, ed. altera, p. 346; 1767, Systema naturae, ed. 12, vol. 1, pt. 2, p. 878.—Clerck, 1759, Icones insectorum, pl. 2, fig. 7. Gmelin, 1788, Systema naturae, ed. 13, vol. 1, p. 2508.—Villers, 1789, Caroli Linnaei entomologia . . . , vol. 2, p. 398.

Pyralis hastiana.—Fabricius, 1774, Systema entomologiae, p. 650; 1781, Species insectorum, vol. 2, p. 282; 1787, Mantissa insectorum, vol. 2, p. 230; 1794, Entomologia systematica, vol. 3, pt. 2, p. 261.

Teras hastiana.—Treitschke, 1830, Schmetterlinge von Europa, vol. 8, p. 266.—Guenée, 1845, Ann. Soc. Ent. France, ser. 2, vol. 3, p. 144; [1846], Europaeorum Microlepidopterorum index methodicus, p. 10, 1845.—Lederer, 1859, Wiener Ent. Monatschr., vol. 3, p. 151.—Wocke, 1861, *in* Staudinger and Wocke, Catalog der Lepidopteren Europa's, p. 94, no. 553; 1871, *in* Staudinger and Wocke, Catalog der Lepidopteren des europaeischen Faunengebiets, p. 232, no. 652.—Walker, 1863, List of the specimens of lepidopterous insects in the British Museum, pt. 27, p. 207.—Heinemann, 1863, Schmetterlinge Deutschlands und der Schweiz, Abth. 2, vol. 1, pt. 1, p. 14.—Millière, 1874, Mém. Soc. Sci. Nat. Cannes, vol. 4, p. 68.—Snellen, 1882, Vlinders van Nederland, Microlepidoptera, p. 177.—Fernald, 1882, Trans. Amer. Ent. Soc., vol. 10, p. 6.—Grote, 1882, New check list of North American moths, p. 57, no. 11.

Peronea coronana.—Wood (not Thunberg), 1839, Index entomologicus, p. 157, pl. 35, fig. 1072.

Teras scabrana.—Guenée (not Schiffermiller and Denis), 1845, Ann. Soc. Ent. France, ser. 2, vol. 3, p. 145; [1846], Europaeorum Microlepidopterorum index methodicus, p. 11, 1845.

?*Rhyacionia hastiana*.—Westwood and Humphreys, 1845, British moths and their transformations, vol. 2, p. 173, pl. 99, fig. 15.

Peronea (*Eclectis*) *hastiana*.—Stephens, 1852, List of the specimens of British animals in the British Museum, pt. 10, p. 14.

Peronea hastiana.—Wilkinson, 1859, British tortrices, p. 171.—Stainton, 1859, Manual of British butterflies and moths, vol. 2, p. 233.—Barrett, 1905, Lepidoptera of the British Islands, vol. 10, p. 224.—Meyrick, 1912, *in* Wagner, Lepidopterorum catalogus, pt. 10, p. 67; 1913, *in* Wytsman, Genera insectorum, fasc. 149, p. 64; 1923, The Ent., vol. 56, p. 162; 1927, Revised handbook of British Lepidoptera, p. 526.—Barnes and McDunnough, 1917, Check list of the Lepidoptera of Boreal America, p. 178, no. 7439.—Sheldon, 1923, The Ent. vol. 56, pp. 75, 100, 149, and 271; 1927, Proc. Ent. Soc. London, vol. 2, p. 1; 1930, The Ent., vol. 63, p. 148.—Forbes, [1924], Cornell Univ. Agr. Exp. Stat. Mem. 68, p. 485 (in part), 1923.—Filipjev, [1930], Ann. Mus. Zool. Acad. Sci. URSS, vol. 30, p. 509, pl. 41, figs. 1 and 3, 1929; [1931] Ann. Mus. Zool. Acad. Sci. URSS, vol. 31, p. 516, pls. 23 (figs. 3 and 3a, b), 28 (fig. 6), 1930.—McDunnough, 1934, Canadian Journ. Res., vol. 11, pp. 301, 326 (fig. 3); 1939, Mem. Southern California Acad. Sci., vol. 2, p. 58, no. 7484.—Lhomme, 1939, Catalogue des lépidoptères de France et de Belgique, vol. 2, p. 300.—Vari, 1944, Ent. Berichten, vol. 11, p. 216, figs. 1, 2.—Obraztsov, 1949, Mitt. Münchener Ent. Ges., vol. 35–39 ("1945–1949"), p. 211.—Benander, 1950, Svensk Insektfauna, pt. 10, p. 12, text fig. 3a, pl. 1 (figs. 2, 3).

Teras pulverosana Walker, 1863, List of the specimens of lepidopterous insects in the British Museum, pt. 28, p. 291.—Walsingham, 1879, Illustrations of typical specimens of Lepidoptera Heterocera, pt. 4, p. 3, pl. 61, fig. 7.—Fernald, 1882, Trans. Amer. Ent. Soc., vol. 10, p. 7.—Grote, 1882, New check list of North American moths, p. 57, no. 12. New synonym.

Tortrix scabrana.—Werneburg (not Schiffermiller and Denis), 1864, Beiträge zur Schmetterlingskunde, vol. 1, p. 548.

Teras hastiana aberration *coronana*.—Wocke (not Thunberg), 1871, *in* Staudinger and Wocke, Catalog der Lepidopteren des europaeischen Faunengebiets, p. 232, no. 652a.

Teras pastiana [sic].—Murtfeldt, 1893, Insect life, vol. 5, p. 155.

Acalla hastiana.—Meyrick, 1895, Handbook of British Lepidoptera, p. 521.—Rebel, 1901, *in* Staudinger and Rebel, Catalog der Lepidopteren des palaearctischen Faunengebietes, vol. 2, p. 80, no. 1446.—Kennel, 1908, Die palaearktischen Tortriciden, p. 70, pl. 3, fig. 33.—Krulikovskij, [1908], Rev. Russe Ent., vol. 7, p. 104, 1907.—Müller-Rutz, 1924, Mitt. Schweizerischen Ent. Ges., vol. 13, p. 348.—Petersen, 1924, Lepidopteren-Fauna von Estland, pp. 335 and 417.—Dufrane, 1933, Lambillionea, vol. 33, p. 196, 1 pl.—Benander, 1934, Ent. Tidskr., vol. 55, p. 122, pl. 1, fig. 4.

Teras hastianum.—Reutti, 1898, Uebersicht der Lepidopteren-Fauna des Grossherzogthums Baden, ed. 2, p. 209.

Acalla hastiana aberration *coronana* (*in part*).—Rebel, 1901, *in* Staudinger and Rebel, Catalog der Lepidopteren des palaearctischen Faunengebietes, vol. 2, p. 80, no. 1446a.—Kennel, 1908, Die palaearktischen Tortriciden, p. 71.

Alceris [sic] *hastiana*.—Fernald, [1903], U.S. Nat. Mus. Bull. 52, p. 473, no. 5309, 1902.—Fracker, 1915, Illinois Biol. Monogr., vol. 2, no. 1, p. 74.

Alceris [sic] *pulverosana*.—Fernald, [1903], U.S. Nat. Mus. Bull. 52, p. 473, no. 5310, 1902.

Peronea pulverosana.—Meyrick, 1912, *in* Wagner, Lepidopterorum catalogus, pt. 10, p. 64; 1913, *in* Wytsman, Genera insectorum, fasc. 149, p. 63.—Barnes and McDunnough, 1917, Check list of the Lepidoptera of Boreal America, p. 178, no. 7428.—McDunnough, 1934, Canadian Journ. Res., vol. 11, pp.

302, 326 (fig. 5), 330 (fig. 4); 1939, Mem. Southern California Acad. Sci., vol. 2, p. 58, no. 7486.

Eclectis hastiana.—Pierce and Metcalfe, 1922, Genitalia of the group Tortricidae, p. 18, pl. 7 (genitalia of female, not those of male); 1935, Genitalia of the tineid families, p. 114.

Peronea maccana.—Pierce and Metcalfe, 1922, Genitalia of the group Tortricidae, p. 21, pl. 8 (genitalia of male, not those of female).

Acleris hastiana.—Obraztsov, 1956, Tijdschr. Ent., vol. 99, p. 137; 1957, Tijdschr. Ent. vol. 100, p. 330 (synomymy and list of individual forms).

McDunnough (1934) applied the name *pulverosana* to some specimens from Canada, although with some doubts. The present author has no objection to this application of the above name, because the external characters of the specimens with the genitalia of McDunnough conception of *pulverosana* correspond quite well to the type of this species. McDunnough treated *pulverosana* as a separate species, but, as he wrote himself, the genitalic distinction between it and *hastiana* is minimal, and the females of the two species cannot be satisfactorily differentiated. The socii of the male genitalia *pulverosana* are less distinct distally and more nearly circular in outline, the sedoeagus is slightly longer and narrower, and the armature of the vesica consists of three cornuti. In both *pulverosana* and *hastiana*, a triangular piece of chitin is present in the armature of the vesica.

The latter character seems to the present author to be of special taxonomic significance when considering *pulverosana* and *hastiana* as being conspecific. The number of cornuti varies in *hastiana* from three to six (Obraztsov, 1949); even in some Canadian specimens of *hastiana*, there are only three cornuti present, as in *pulverosana*. In the European specimens of *hastiana*, many of which were examined by the present author, the cornuti vary in their thickness and length. The shape of the socii is also inconstant in large series of *hastiana*, and some European specimens have nearly circular socii. Inasmuch as in Manitoba both *pulverosana* and *hastiana* are present, there is no reason to suppose in *pulverosana* a geographical subspecies of *hastiana*, and it should be treated as an individual form. Until a revision of individual variation of *hastiana* in North America is done, *pulverosana* becomes a synonym of *hastiana*.

The present author examined some specimens which belong in all probability to *hastiana* but which have no cornuti. In a series from Watsonville, Calif. (September 1919, D. Penny; genitalia on slides 1–Obr., 2–Obr., and 3–Obr., Jan 5, 1959; in USNM), consisting of three males, one specimen only has four minute dots of the vesica, which show the places on which the cornuti were fixed. There is also a male specimen without cornuti from Verdi, Nev. (June 20–30, A. H. Vachell; genitalia on slide 434–Obr.; AMNH).

In redescription of *celiana* Robinson, McDunnough (1934, p. 302) wrote that the red-brown tufting of the thorax is apparently lacking in *hastiana*. The present author had at hand many specimens of *hastiana*, especially from Europe, in which a red-brown tuft was well developed.

TYPES.—Lectotype of *hastiana* (selected by Sheldon, 1923), figured by Clerck, 1759, Icones insectorum, pl. 2, fig. 7. Holotype of *pulverosana*, female (without abdomen), St. Martins Falls, Albany River, Hudsons Bay, Canada, 1844 (Barnston), BM. Walker erroneously indicated this specimen as male.

Acleris walkerana (McDunnough), new combination

PLATES 9 (FIG. 30), 10 (FIG. 35)

Peronea walkerana McDunnough, 1934, Canadian Journ. Res., vol. 11, pp. 303, 326 (fig. 6), 330 (fig. 5); 1939, Mem. Southern California Acad. Sci., vol. 2, p. 58, no. 7487; 1942, Canadian Ent., vol. 74, p. 70.

Peronea caryosphena Meyrick, 1937, Exotic Microlepidoptera, vol. 5, p. 157.—McDunnough, 1939, Mem. Southern California Acad. Sci., vol. 2, p. 58, no. 7488.—Lesse and Viette, 1946, Ann. Soc. Ent. France, vol. 115, p. 90, figs. 10 and 14. New synonym.

Through the kindness of Dr. Pierre E. L. Viette (Muséum National d'Histoire Naturelle, Paris), the present author had an opportunity to study *Peronea caryosphena*, described by E. Meyrick from Greenland. The examined series consisted of two males and two females taken in Greenland in 1949 and identified by Dr. Viette. The moths vary considerably, and some have almost unicolorous gray forewings. The antemedian band and groups of raised scales are typical of fresh specimens which, in addition, have the forewings slightly powdered with pale-grayish scales. In the genitalia, the specimens from Greenland do not differ from *Peronea walkerana* described by J. McDunnough from Ontario and Quebec.

The male genitalia of *walkerana* resemble those of *Acleris hastiana* (Linné), but they differ from them in the shape of some parts. The cristae of the tegumen of *walkerana* are strongly reduced, the anal spine of the gnathos is stronger than that of *hastiana*, and the angle before half of the sacculus is more pointed. The length of the cornuti and the shape of the socii are rather inconstant in both of these species. The female genitalia give a solid basis for distinguishing *walkerana* and *hastiana*.

SPECIMENS EXAMINED.—One female paratype of *walkerana* (genitalia on slide P. 43a), Aylmer, Quebec, Apr. 25, 1924 (C. H. Curran), USNM. Two males and two females (genitalia on slides 1-Obr. and 2-Obr.), western Greenland, 69° 45′ E., Aug. 22–25, 1949 (Mission P. E. Victor H. de Lesse, 1949), in the Muséum National d'Histoire Naturelle, Paris.

***Acleris robinsoniana* (Forbes), new combination**

Teras flavivittana.—Robinson (not Clemens), 1869, Trans. Amer. Ent. Soc., vol. 2, p. 280, pl. 7, fig. 61.—Fernald, 1882, Trans. Amer. Ent. Soc., vol. 10, p. 7 (in part).

Acleris [sic] *hastiana flavivittana* (in part).—Fernald, [1903], U.S. Nat. Mus. Bull. 52, p. 473, no. 5309b, 1902.

Peronea hastiana (in part).—Meyrick, 1912, *in* Wagner, Lepidopterorum catalogus, pt. 10, p. 68.

Peronea robinsoniana Forbes, [1924], Cornell Univ. Agr. Exp. Stat. Mem. 68, p. 487, 1923.—McDunnough, 1934, Canadian Journ. Res., vol. 11, pp. 304, 326 (fig. 7), 330 (fig. 6); 1939 Mem. Southern California Acad. Sci., vol. 2, p. 58, no. 7490.

Peronea robinsonana [sic].—Klots, 1942, Bull. Amer. Mus. Nat. Hist., vol. 79, p. 394 and 415.

Forbes (1924) gave a short description of this species, believing that it was already published by Kearfott, and supposed it a probable variety of the European *Acleris permutana* (Duponchel). He did not mark with his labels any specimen of the type series of *robinsoniana* in the American Museum of Natural History, and McDunnough (1934) was the first who selected ten specimens in that collection as cotypes of this species. These specimens correspond well with Forbes' original description of *robinsoniana*. Klots (1942) found it logical not to restrict the type material of *robinsoniana* to the ten specimens selected by McDunnough as "cotypes," but to treat all 83 specimens, placed under this name in the Kearfott Collection, as the type lot, inasmuch as Forbes did not select any preferred specimens. Although not all these "lectoparatypes" (as Klots called them) belong to the nominate form of *robinsoniana*, the present author completely agrees with Klots' proposal, especially in view of the fact that McDunnough's selection was rather arbitrary because his "cotypes" did not include all the specimens which correspond to the nominate form of this species. There are nine more specimens of the nominate form of *robinsoniana* in the type lot used by Forbes for his description, and these specimens were not indicated by McDunnough as "cotypes." Even though, in consequence of the proposal of Klots, the type series of *robinsoniana* became somewhat "motley" because of the many varieties which it includes, the lectotype selected by Klots is completely typical of the nominate form of this species. The entire type lot of *robinsoniana* in the American Museum of Natural History includes the following forms.

Form *a*, nominate form

Forewings along dorsum with a pale-yellow streak slightly widened externad; remainder brown, darker basad and apicad.

TYPES.—Lectotype of *robinsoniana* (selected by Klots, 1942), male, Hampton, N.H., Apr. 29, 1907 [not 1909!] (S. A. Shaw); 19 paratypes

from the same locality, Aweme, Manitoba (N. Criddle), and Holly Beach, N.J., March 7, 1900 (F. Haimbach).

OTHER SPECIMEN EXAMINED.— One female (genitalia on slide 425-Obr.), Red Rock Lake, Whiteshell Forest Reserve, Manitoba, June 6, 1954 (C. D. Bird).

Form *b*

Forewings reddish brown; a minute discal dot and very fine lines (some along vein A_{2+3}, one or two at wing apex, and sometimes some at lower margin of discal cell and cubital veins), white.

SPECIMENS EXAMINED.—Nine specimens (among them eight paratypes of *robinsoniana*), Hampton, N.H. (S. A. Shaw).

Form *c*

As the form *b*, but with a broad whitish transverse fascia before middle of forewing.

SPECIMEN EXAMINED.—One male (paratype of *robinsoniana*), Hampton, N.H. (S. A. Shaw).

Form *d*

Forewings brownish ochreous with an obliterate dark-brown costal spot and a blackish spot in basal part of wing.

SPECIMENS EXAMINED.—Seven specimens (paratypes of *robinsoniana*), Hampton, N.H. (S. A. Shaw).

Form *e*

The most common variety described by McDunnough (1934). Color and maculation as in *Acleris inana* (Robinson).

SPECIMENS EXAMINED.—Forty specimens (paratypes of *robinsoniana*; genitalia of two males and one female on slides 212–Obr., 571-Obr., and 572–Obr.), Hampton, N.H. (S. A. Shaw), and Aweme, Manitoba (N. Criddle).

Form *f*

Forewings blackish brown; a spot in discal cell, and tornal part of wing, ochreous. This form received a separate name, and is known as form *clemensiana* Forbes (see below).

***Acleris robinsoniana* (Forbes) form *clemensiana* Forbes**

Peronea clemensiana Forbes, [1924], Cornell Univ. Agr. Exp. Stat. Mem. 68, p. 487, 1923.—Klots, 1942, Bull. Amer. Mus. Nat. Hist., vol. 79, pp. 394 and 413.

Peronea robinsoniana form *clemensiana*.—McDunnough, 1934, Canadian Journ. Res., vol. 11, p. 304; 1939, Mem. Southern California Acad. Sci., vol. 2, p. 58, no. 7490.

As with the nominate form of *robinsoniana*, Klots (1942) also changed the number of the specimens of *clemensiana* in the collection

of the American Museum of Natural History that should be treated as lectoparatypes, and selected the lectotype. The present author concurs with this proposal of Klots.

TYPES.—Lectotype (selected by Klots, 1942), male, Hampton, N.H., Oct. 27, 1908 (S. A. Shaw); nine paratypes, the above locality, and Montclair, N.J., Feb. 1, 1903 (W. D. Kearfott). The entire type series in AMNH.

OTHER SPECIMENS EXAMINED.—Six specimens (paratypes of *robinsoniana*), Hampton, N.H. (S. A. Shaw), AMNH.

Acleris britannia Kearfott

Acleris britannia Kearfott, 1904, Canadian Ent., vol. 36, p. 138.—Klots, 1942, Bull. Amer. Mus. Nat. Hist., vol. 79, p. 413.

Peronea britannia.—Meyrick, 1912, *in* Wagner, Lepidopterorum catalogus, pt. 10, p. 61; 1913, *in* Wytsman, Genera insectorum, fasc. 149, p. 62—Barnes and McDunnough, 1917, Check list of the Lepidoptera of Boreal America, p. 178, no. 7414.—McDunnough, 1934, Canadian Journ. Res., vol. 11, pp. 306, 326 (fig. 10) 330 (fig. 9); 1939, Mem. Southern California Acad. Sci., vol. 2, p. 59, no. 7493.

Alceris [sic] *britannia*.—Fracker, 1915, Illinois Biol. Monogr., vol. 2, no. 1, p. 74.

In the original description of this species, Kearfott indicated as its type a specimen in the U.S. National Museum ("type no. 7784"). The specimen in the American Museum of Natural History, selected for a lectotype (Klots, 1942), is, therefore, merely a paratype. An examination of the male genitalia of *britannia* has showed that they differ a little from those of McDunnough's (1943) figure in having the sacculus before its emargination more acute and the subapical spine of the aedoeagus somewhat longer. The number of cornuti in this species probably varies because in one male there are only three cornuti instead of four arranged in two pairs. The female genitalia of *britannia* are quite accurately figured by McDunnough.

TYPES.—Holotype ("type no. 7784"), male (genitalia on slide, prepared by A. Busck, Apr. 21, 1935), Kaslo, British Columbia (Dyar, no. 39083); paratype, female (genitalia on the same slide), same data (Dyar, no. 27985); both in USNM. Paratype ("lectotype" of Klots, 1942), female (genitalia on slide 206-Obr.; this specimen was listed by Klots, 1942, as male), same data (N. Criddle; Dyar, no. 21082), AMNH.

REMARKS.—Besides the nominate form redescribed by McDunnough (1934), the present author examined two individual forms of *britannia*, very striking and looking like two separate species, but in the genitalia not differing from *britannia*. Pending a revision of the variation of this species, these two forms are described below without names.

Form *a*

PLATE 2 (FIG. 6)

Basal part, a little less than half of forewing, white or yellowish with a brown short oblique streak or triangle at dorsum, and black well-developed raised scales on this streak; entire external part of forewing brown or yellowish brown with a slightly darker obliterate costal triangle. Some small groups of black raised scales at border of these two so differently colored areas. Some interrupted blackish transverse (in external part of forewing, oblique) lines crossing both areas. Costa of forewing with gray obliterate lines and minute dots. Hind wing grayish white with slight dark reticulation.

At first sight, this form may remind one of *Acleris variegana* (Schiffermiller and Denis). Although all known specimens of this form originate from the State of Washington, it does not represent there a constant subspecies. The nominate form of *britannia* is also known from this state.

SPECIMENS EXAMINED.—State of Washington: one male (genitalia on slide 6097, prepared by J. F. Gates Clarke, Nov. 7, 1934), Puyallup, Pierce County, Aug. 20, 1930 (T. C. Clarke); one male, Toledo, Lewis County, Aug. 5, 1931 (J. F. Gates Clarke); three males (genitalia of one on slide 1–Obr., Feb. 25, 1959), Bonneville, Clark County, July 15–16, 1931 (J. F. Gates Clark); all specimens in USNM.

Form *b*

PLATE 2 (FIG. 5)

Forewing yellowish brown, with a slightly darker indistinct costal triangle and black raised scales arranged as in former variety. A tuft of whitish raised scales on discocellulars. Some dark transverse lines well developed in external part of forewing. Hind wing grayish white with gray reticulation.

SPECIMEN EXAMINED.—One female (genitalia on slide, prepared by A. Busck, Oct. 11, 1924), Biological Station, Departure Bay, British Columbia, Aug. 5, 1909 (A. W. Hanham), USNM.

***Acleris klotsi*, new species**

FIGURE 4; PLATE 3 (FIGS. 7, 8)

Head, labial palpi, thorax, and forewings whitish ochreous. Antennae concolorous, with darker annulation. Abdomen pale grayish. Forewings with three parallel oblique ochreous bands almost equally spaced: first from about one-quarter of costa to one-third of dorsum, second from about middle of costa to two-thirds of dorsum, third from three-quarters of costa to tornus. Upper part of second band somewhat darker, connected by a line with third band below costa,

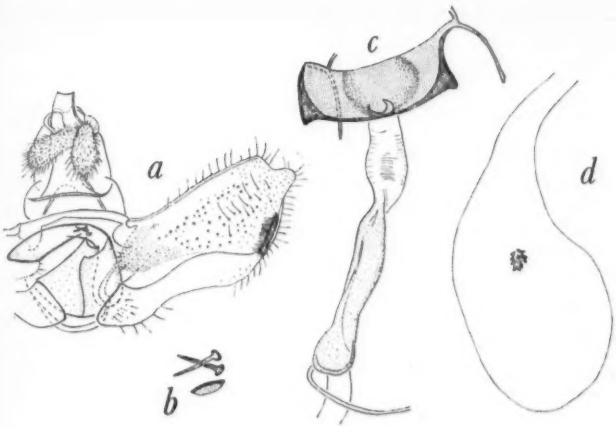

FIGURE 4.—*Acleris klotsi*, new species: *a*, male genitalia (paratype; slide 179-Obr.); *b*, cornuti (more enlarged); *c*, female genitalia (allotype).

an obliterate costal triangle thus formed. Groups of black raised scales easily falling off: one on first band between discal cell and dorsum, five others along second band. An obliterate ochreous shadow between two external bands, and a similar narrow line parallel to third band, between it and termen. Cilia whitish ochreous with a brownish basal line. Reverse of forewings paler than their upper surface, with brownish-gray dots and short lines matching markings of upper surface. Length of forewing, 7–8 mm. Hind wings white.

MALE GENITALIA.—Tegumen without cristae; gnathos simple without middle spine; socii ovate. Valvae elongate; brachiola indicated by a slight obtuse projection; sacculus rather broad, sinuate; external tuft narrow. Aedoeagus strongly curved; vesica armed with a semiovate plate and two cornuti capitate at base.

FEMALE GENITALIA.—Sterigma with very short lateral lobes. Antrum narrow, semilunar, pointing caudad. Ductus bursae rather long, semimembranous and narrow in long cephalic portion, dilated and membranous caudad. Cervix bursae moderate; corpus bursae slightly elongate; signum stellate, scobinate, somewhat elongate.

TYPES.—Holotype, male, Ramsay Canyon, Huachuca Mountains, Ariz., July 10–15, 1941 (A. B. Klots); allotype, female (genitalia on slide 180-Obr.), the same data; three male paratypes (genitalia of one on slide 179-Obr.). All types in AMNH.

REMARKS.—In its appearance this new species has no close resemblance to any Nearctic *Acleris* species, although it might perhaps remind one of *A. britannia* Kearfott, in which however the forewing markings are probably never so obliterate. The genitalia are very

typical of the new species, and separate it well from all known *Acleris* species.

***Acleris maculidorsana* (Clemens)**

Cnephasia ? maculidorsana Clemens, 1864, Proc. Ent. Soc. Philadelphia, vol. 3, p. 516.

Teras maculidorsana.—Robinson, 1869, Trans. Amer. Ent. Soc., vol. 2, p. 281, pl. 7, fig. 64.—Zeller, 1875, Verhandl. zool.-bot. Ges. Wien, vol. 25, p. 213.—Moffat, 1887, Canadian Ent., vol. 19, p. 88.

Teras hastiana var. *maculidorsana.*—Walsingham, 1879, Illustrations of typical specimens of Lepidoptera Heterocera, pt. 4, p. 76.—Fernald, 1882, Trans. Amer. Ent. Soc., vol. 10, p. 7.—Grote, 1882, New check list of North American moths, p. 57, no. 11.

Alceris [sic] *hastiana maculidorsana.*—Fernald, [1903], U.S. Nat. Mus. Bull. 52, p. 473, no. 5309d, 1902.

Peronea hypericana Ely, 1910, Proc. Ent. Soc. Washington, vol. 12, p. 68.—Meyrick, 1912, *in* Wagner, Lepidopterorum catalogus, pt. 10, p. 61; 1913, *in* Wytsman, Genera insectorum, fasc. 149, p. 62.—Barnes and McDunnough, 1917, Check list of the Lepidoptera of Boreal America, p. 178, no. 7418.

Peronea maculidorsana.—Meyrick, 1912, *in* Wagner, Lepidopterorum catalogus, pt. 10, p. 64; 1913, *in* Wytsman, Genera insectorum, fasc. 149, p. 63.—Barnes and McDunnough, 1917, Check list of the Lepidoptera of Boreal America, p. 178, no. 7431.—Forbes, [1924], Cornell Univ. Agr. Exp. Stat. Mem. 68, p. 486, 1923.—McDunnough, 1934, Canadian Journ. Res. vol. 11, pp. 310, 327, (fig. 10), 331 (fig. 2); 1939, Mem. Southern California Acad. Sci., vol. 2, p. 59, no. 7497; 1940, Canadian Ent., vol. 72, p. 60.—Darlington, 1947, Trans. Amer. Ent. Soc., vol. 73, p. 103.

On the basis of examination of two genitalia slides, McDunnough (1934) wrote about the armature of the vesica of *maculidorsana* that it consists in this species of a bundle of small cornuti, variable in number (8 to 12 in the specimens examined by McDunnough). In six slides of the male genitalia of *maculidorsana* examined by the present author, the cornuti form two groups, one basal and one distal, distinctly separated one from the other. Only in one specimen (Whitesbog, N.J.) was this separation not clearly seen, perhaps because of an inappropriate position of the aedoeagus on the slide. The basal group of the cornuti consists of two rather stout, almost equally sized needles; they were seen also in the above specimen from Whitesbog. Judging from the examined slides, the number of the cornuti in the distal group varies from six to eight. These cornuti are thinner and about 1½ times as long as the basal ones. On the figure published by McDunnough (1934, p. 327, fig. 10), these two groups of the cornuti are seen quite distinctly, although the difference of their lengths is not shown. It should also be mentioned that the apical spine of the vesica (the so-called "rose-thorn") was directed inward toward the aedoeagus tube in all the examined slides.

SPECIMENS EXAMINED.—One male (genitalia on slide 422-Obr.), Red Rock Lake, Whiteshell Forest Reserve, Manitoba, May 13, 1954

(C. D. Bird), AMNH. One male (genitalia on slide 458-Obr.), Montclair, N.J., Nov. 2, 1903 (W. D. Kearfott), AMNH. One male (genitalia on slide, prepared by A. Busck, May 8, 1935), Whitesbog, N.J., Dec. 1, 1914 (H. B. Scammell), USNM. One male (genitalia on slide, prepared by A. Busck, May 7, 1935), Fishers Falls, Pa., Apr. 28, 1884, in USNM. Two males (genitalia on slides 215-Obr. and 216-Obr.), Hampton, N.H., Oct. 20, 1907, and Oct. 28, 1908 (S. A. Shaw), AMNH.

***Acleris clarkei*, new species**

FIGURE 5; PLATE 4 (FIGS. 10, 11)

Antennae dark gray and whitish annulated. Head and thorax whitish gray, latter with a brownish-black margin cephalad. Labial palpi white from inner side and below, dark gray from outer surface; their terminal joint dark gray. Forewings brownish black in two basal thirds, with an incurved outer edge of this area; two whitish costal patches on this ground, incompletely divided by black; sometimes indistinct, whitish spots at dorsum in external part of dark

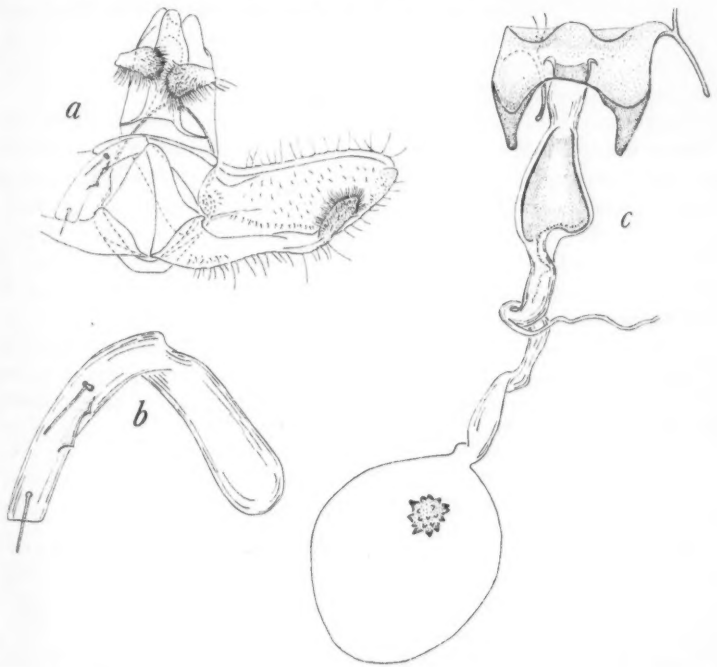

FIGURE 5.—*Acleris clarkei*, new species: *a*, male genitalia (holotype); *b*, cornuti (more enlarged); *c*, female genitalia (paratype).

area, and a slight indication of transverse lines. Outer third of forewing brownish gray-white, irregularly crossed by narrow, slightly oblique, interrupted blackish lines. Terminal line narrow, blackish. Cilia concolorous with outer part of forewing. Length of forewing, 7–8 mm. Hind wings smoky white; cilia white.

MALE GENITALIA.—Tegumen moderate; gnathos smooth; socii band-like, rather broad. Valvae elongate; brachiola slightly indicated; sacculus somewhat concave at middle; external tuft rather broad. Aedoeagus geniculate, with a bicuspidate carina on outer surface; vesica with two rather long cornuti capitate at their bases.

FEMALE GENITALIA.—Sterigma with moderately long, parallel coniform lateral lobes rotundate at tips. Antrum subrectangular with caudal angles curved laterocephalad. Ductus bursae moderately long, dilated, and sclerotized at middle. Cervix bursae moderate; corpus bursae rotundate with a large stellate scobinate signum.

TYPES.—Holotype, male (genitalia on slide, prepared Nov. 5, 1934, by J. F. Gates Clarke), Cle Elum, Kittitas County, Wash., Apr. 9, 1931 (J. F. Gates Clarke); allotype, female, Aweme, Manitoba, Apr. 18, 1905 (N. Criddle); one male (without abdomen) and one female (genitalia on slide 1-Obr., Jan. 12, 1959), paratypes, Aweme, Manitoba, Aug. 24, 1907, and Apr. 19, 1908 (N. Criddle). All the above types in USNM (no. 65587).

REMARKS.—In its appearance this species resembles no other known *Acleris* species, and might perhaps remind one rather of an *Apotomis* or *Endothenia* species. The form of the socii is somewhat similar to that in the *Acleris hastiana* group, but the sculpture of the outer surface of the aedoeagus is perhaps unique in the entire genus *Acleris*. The female genitalia of the new species are rather close to those of *cervinana* and *subnivana*, and they differ from them in the shape of the antrum.

This new species is named for Dr. J. F. Gates Clarke, of the U.S. National Museum, who directed the attention of the present author to this and some other *Acleris* species in the collection of the above museum.

Acleris capizziana, new species

FIGURE 6,*a* ; PLATE 1 (FIGS. 2, 3)

MALE.—Antennae gray with blackish obliterate annulation more distinct apicad. Head gray with scales dark patched at middle and white edged apicad; some pinkish-brown scales at head sides. Labial palpi above concolorous with head, below and at inside cream white. Patagia and tegulae gray with scales whitish edged distad. Thorax gray, distinctly darker than head. Forewings gray with pinkish-brown obliterate irregular markings formed by an area at base of

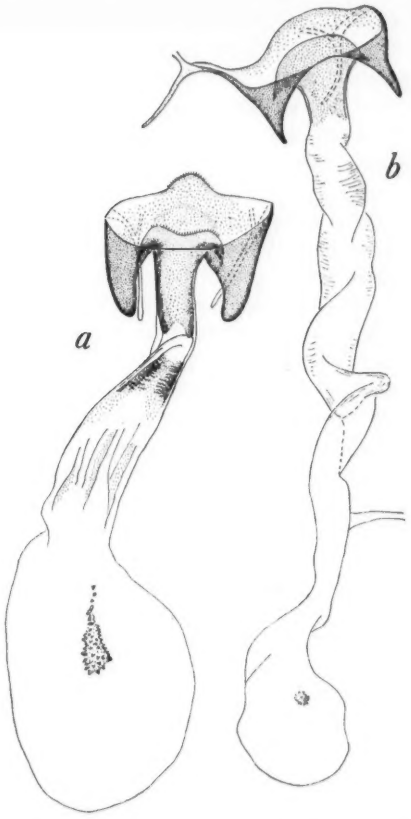

FIGURE 6.—Female genitalia of two *Acleris* species: *a*, *A. capizziana*, new species; *b*, *A. incognita*, new species.

costa, an oblique precostal line at middle, an angulate precostal line instead of a regular costal triangle before wing apex, some preterminal dots, and a diffuse darkening dorsad from discal cell. Small groups of brown to black raised scales: two in discal cell, one above its last third, and one below its basal third. Some minute dark dots along veins of discal cell and in other parts of wing. Cilia concolorous with head. Length of forewing, 10 mm. Hind wings smoky white. Foretibiae and tarsi pinkish brown above.

FEMALE.—Antennae, head, labial palpi, patagia, tegulae, and thorax as in male. Forewings whitish gray to gray with dark pinkish-brown markings formed by an area at base of costa, a short precostal oblique line in first third wing, a broader and longer precostal oblique line at

wing middle, connected with a concolorous flat costal triangle reaching to wing apex, and a rather broad terminal line. Most of supradorsal area below discal cell darkened with brown. Some concolorous dots in discal cell and other parts of wing. Small inconstant groups of black raised scales around discal cell. Cilia concolorous with head or somewhat paler. Length of forewing, 9–10 mm. Hind wings pale smoky.

MALE GENITALIA.—Unknown.

FEMALE GENITALIA.—Sterigma with long broad lateral lobes rotundate at tips and slightly bent inward apically. Ostium bursae broad, sinuate. Antrum a broad sclerotized tube, slightly longer than lateral lobes of sterigma, dilated caudad, excavate cephalad; angles of antrum laterad from ostium bursae bent cephalad and rather long. Bursa copulatrix with a broad cervix sclerotized caudad; its corpus ovate. Signum elongate, scobinate, narrowed caudad.

TYPES.—Holotype, female (genitalia on slide 2-Obr., Feb. 16, 1959), Bendon, Oreg., Sept. 24, 1956 (J. Capizzi); allotype, male, and two female paratypes, taken together with holotype. All the above types in USNM (no. 65588).

FOOD PLANT.—All four examined specimens were reared from strawberry.

REMARKS.—The abdomen of the single male specimen was received preprepared, glued to a piece of paper, with the genitalia missing. Externally this male is somewhat similar to *Acleris lipsiana* (Schiffermiller and Denis), but has obliterate markings of forewings that are lacking in the latter species. The females might remind one somewhat of *Acleris maccana* (Treitschke) aberration *leporinana* Zetterstedt (Kennel, 1908, pl. 4, fig. 20), although they do not match its markings exactly. The female genitalia of the new species are similar to those of *lipsiana*, but the antrum is shorter and broader, and the ductus seminalis is joined to the ductus bursae remote from the antrum; in *lipsiana* the ductus seminalis opens directly cephalad from the antrum. The new species is named for its collector.

Acleris incognita, new species

FIGURE 6,*b*; PLATE 3 (FIG. 9)

MALE.—Unknown.

FEMALE.—Head dark brownish gray with scales white edged. Labial palpi concolorous with head, their inner side whitish. Thorax dark brownish gray. Forewings concolorous with head, but scales not white edged. Base of costa, a large obliterate costal patch over middle of discal cell and a longitudinal streak in this latter, last quarter of wing and some of external veins brown scaled. Groups of

yellowish raised scales forming distinct patches: one in basal part of discal cell, and three in its distal part. Some less distinct groups of raised scales on costal patch and below discal cell, some above dorsum. Cilia gray with tips of scales paler. Reverse of forewings brownish gray with some obliterate yellowish patches along costa. Length of forewing, 10.5 mm. Hind wings pale grayish white.

FEMALE GENITALIA.—Sterigma with long, rather thin, almost vertical lateral lobes. Antrum sclerotized, elongate rectangular, dilated caudad, with caudal edge crescent, pointing cephalad. Membranous portion of ductus bursae long, broad, equally wide along its entire length. Signum stellate, scobinate.

TYPE.—Holotype, female (genitalia on slide 2–Obr., Dec. 31, 1958), Moscow Mountains, Idaho, Aug. 7, 1933 (J. F. Gates Clarke). In USNM (no. 65589).

FOOD PLANT.—*Alnus* species (corresponding to the data on label).

REMARKS.—Externally this species could easily have been taken for some dark unicolorous specimen of *Acleris hastiana* (Linné), but in the female genitalia it entirely differs from that species, and resembles rather *A. lipsiana* (Schiffermiller and Denis) and *A. apiciana* (Hübner). The antrum of *incognita* is much shorter than in the two latter species, and the lateral lobes of the sterigma are much narrower and are distinctly pointed.

Acleris minuta (Robinson)

Tortrix minuta Robinson, 1869, Trans. Amer. Ent. Soc., vol. 2, p. 276, pl. 6, fig. 49.

Tortrix vacciniivorana Packard, 1870, *in* 17th Ann. Rept. Sec. Massachusetts Board Agr., p. 241; 1870, Injurious insects, p. 9.

Tortrix malivorana Le Baron, 1871, *in* 1st Ann. Rept. Noxious Insects Illinois, for 1870, p. 20.—Riley, 1872, *in* Board Agr., 4th Ann. Rept. Noxious, Beneficial and Other Insects . . . of Missouri, p. 47.

Teras variolana Zeller, 1875, Verhandl. zool.-bot. Ges. Wien, vol. 25, p. 212.

Teras minuta.—Fernald, 1882, Trans. Amer. Ent. Soc., vol. 10, p. 9.—Grote, 1882, New check list of North American moths, p. 57, no. 24.

Teras vacciniivorana.—Fernald, 1882, Trans. Amer. Ent. Soc., vol. 10, p. 9.—Grote, 1882, New check list of North American moths, p. 57, no. 23.

Teras malivorana.—Fernald, 1882, Trans. Amer. Ent. Soc., vol. 10, p. 9.—Grote, 1882, New check list of North American moths, p. 57, no. 22.

Alceris [sic] *minuta*.—Fernald, [1903], Bull. U.S. Nat. Mus. 52, p. 475, no. 5319, 1902.—Fracker, 1915, Illinois Biol. Monogr., vol. 2, no. 1, p. 74.

Peronea minuta.—Meyrick, 1912, *in* Wagner, Lepidopterorum catalogus, pt. 10, p. 61; 1913, *in* Wytsman, Genera insectorum, fasc. 149, p. 62.—Mosher, 1916, Illinois State Lab. Nat. Hist. Bull. 12, p. 57, pls. 21 (fig. 41), 22 (figs. 42–43).—Barnes and McDunnough, 1917, Check list of the Lepidoptera of Boreal America, p. 178, no. 7419.—Forbes, [1924], Cornell Univ. Agr. Exp. Sta. Mem. 68, p. 482, 1923.—McDunnough, 1934, Canadian Journ. Res., vol. 11, pp. 314, 327 (fig. 7), 331 (fig. 8); 1939, Mem. Southern California Acad. Sci., vol. 2, p. 59, no. 7502.

The variation of the nominate form of *minuta* is rather insignificant, but there are specimens with forewings somewhat darker than have usually been observed. The hind wings are pale grayish, as a rule, but in a male from Lakewood, N.J. (July 13, 1902; genitalia on slide 573–Obr.; in AMNH) they are very dark, as in no other of the examined specimens. A rare variety is represented by one male, improperly labelled ("Insectary, June 1908," Kearfott Collection; genitalia on slide 574–Obr.; AMNH). It has the head, thorax, costa of forewings and their cilia orange yellow, but most of the forewings is smoky gray, as in the form *cinderella*.

***Acleris minuta* (Robinson) form *cinderella* Riley**

Tortrix cinderella Riley, 1872, *in* Board Agr., 4th Ann. Rept. Noxious, beneficial and other insects . . . of Missouri, p. 46, fig. 22; 1881, U.S. Ent. Comm. Bull. 6, p. 82.

Teras cinderella.—Fernald, 1882, Trans. Amer. Ent. Soc., vol. 10, p. 9.—Grote, 1882, New check list of North American moths, p. 57, no. 21.

Teras minuta (in part).—Fernald, 1884, Canadian Ent., vol. 16, p. 64.

Alceris [sic] *minuta cinderella*.—Fernald, [1903], U.S. Nat. Mus. Bull. 52, p. 475, no. 5319a, 1902.

Peronea minuta (in part).—Meyrick, 1912, *in* Wagner, Lepidopterorum catalogus, pt. 10, p. 61; 1913, *in* Wytsman, Genera insectorum, fasc. 149, p. 62.

Peronea minuta form (var., fall generation) *cinderella*.—Barnes and McDunnough, 1917, Check list of the Lepidoptera of Boreal America, p. 178, no. 7419.—Forbes, [1924], Cornell Univ. Agr. Exp. Stat. Mem. 68, p. 482, 1923.—McDunnough, 1934, Canadian Journ. Res., vol. 11, p. 314; 1939, Mem. Southern California Acad. Sci., vol. 2, p. 59, no. 7502.

Most of the specimens examined by the present author have the forewings 5–7 mm. in length. Only in one male, improperly labelled ("Exp. 328, 13 Oct. 1908," Kearfott Collection; genitalia on slide 575-Obr.; AMNH), the length of the forewing is 9 mm.

***Acleris gloverana* (Walsingham), new combination**

PLATE 9 (FIG. 31)

Lophoderus gloveranus Walsingham, 1879, Illustrations of typical specimens of Lepidoptera Heterocera, pt. 4, p. 14, pl. 63, fig. 7.

Lophoderus gloverana (in part).—Fernald, 1882, Trans. Amer. Ent. Soc., vol. 10, p. 16.—Grote, 1882, New check list of North American moths, p. 58, no. 63.

Eulia gloverana (in part).—Fernald, [1903], U.S. Nat. Mus. Bull. 52, p. 485, no. 5425, 1902.—Meyrick, 1912, *in* Wagner, Lepidopterorum catalogus, pt. 10, p. 40; 1913, *in* Wytsman, Genera insectorum, fasc. 149, p. 39.—Barnes and McDunnough, 1917, Check list of the Lepidoptera of Boreal America, p. 177, no. 7393.

Argyrotaenia gloverana.—McDunnough, 1939, Mem. Southern California Acad. Sci., vol. 2, p. 58, no. 7448.—Freeman, 1944, Sci. Agr., vol. 25, p. 92; 1958, Canadian Ent., vol. 90, suppl. 7, p. 52.

The type specimen of *Lophoderus gloveranus* is a male in the collection of the British Museum (Natural History), which the present

author had opportunity to study during his visit to London in 1958. Its genitalia, preprepared and for many years kept dry in a vial, are now on a slide. Unfortunately it was impossible to bring them to a position suitable for a complete examination. It is nevertheless seen from the slide (and the photograph) that they belong to a species of the genus *Acleris* which is related to *A. busckana* (McDunnough). The well-developed cristae of the tegumen and the shape of the valvae are especially characteristic of this little-known species.

TYPE.—Holotype, male (genitalia on slide 5353), Sheep Rock, Siskiyou County, Calif., Sept. 3, 1871 (Walsingham); in BM.

REMARKS.—Walsingham (1879) described *gloverana* as a member of the genus "*Lophoderus*" Stephens. Fernald (1903) placed it in the genus *Eulia* Hübner which is an older synonym of *Lophoderus*. Probably he confused specimens of some other species with *gloverana*, inasmuch as besides California, the type locality of *gloverana*, he mentioned also the State of New York. Forbes (1924) applied the name *gloverana* for a species of the section *Argyrotaenia* Stephens of the genus "*Eulia*," recorded in Massachusetts and New York. The record in the Pacific States Forbes in all probability added on the basis of Walsingham's original data for *gloverana*. The characters of the species called by Forbes "*Eulia* (*Argyrotaenia*) *gloverana*" correspond rather to the species known recently as *Argyrotaenia repertana* Freeman. In his review of the North American *Argyrotaenia* species, Freeman (1944) mentioned *gloverana* as a species unknown to him. In his recent paper, Freeman (1958) suggested that *gloverana* might perhaps be a form of *Acleris variana* (Fernald). None of the above authors had seen the type specimen of *gloverana*, and they based their suggestions about this species exclusively upon the original description and figure of it published by Walsingham.

Acleris maccana (Treitschke)

?*Pyralis repandana* Fabricius, 1798, Supplementum entomologiae systematicae, p. 478.

Peronea marmorana ?Curtis, 1829, British entomology, expl. pl. 16, p. 6.—Westwood and Humphreys, 1845, British moths and their transformations, vol. 2, p. 159, pl. 94, fig. 9.

Teras maccana Treitschke, 1835, Schmetterlinge von Europa, vol. 10, pt. 3, p. 133.—Guenée, 1845, Ann. Soc. Ent. France, ser. 2, vol. 3, p. 143; [1846], Europaeorum Microlepidopterorum index methodicus, p. 9, 1845.—Herrich-Schäffer, 1847, Systematische Bearbeitung der Schmetterlinge von Europa, vol. 4, Tortricides, pl. 3, figs. 14–15; 1851, Systematische Bearbeitung der Schmetterlinge von Europa, vol. 4, p. 149.—Lederer, 1859, Wiener Ent. Monatschr., vol. 3, p. 152.—Wocke, 1861, *in* Staudinger and Wocke, Catalog der Lepidopteren Europas, p. 94, no. 555; 1871, *in* Staudinger and Wocke, Catalog der Lepidopteren des europaeischen Faunengebiets, p. 233, no. 654.—Walker, 1863, List of the specimens of lepidopterous insects in the British Museum

pt. 27, p. 208.—Heinemann, 1863, Schmetterlinge Deutschlands und der Schweiz, Abth. 2, vol. 1, pt. 1, p. 16.—Walsingham, 1879, Illustrations of typical specimens of Lepidoptera Heterocera, pt. 4, p. 76.—Fernald, 1882, Trans. Amer. Ent. Soc., vol. 10, p. 7.—Grote, 1882, New check list of North American moths, p. 57, no. 13.

Teras abietana (in part).—Fischer von Röslerstamm, 1837, Abbildungen zur Berichtigung und Ergänzung der Schmetterlingskunde, p. 69, pl. 34, figs. a–c.

Teras torquana Zetterstedt, 1840, Insecta Lapponica, p. 989.

Glyphiptera maccana.—Duponchel, 1845, Catalogue méthodique des lépidoptères d'Europe, p. 293.

Peronea (*Lopas*) *maccana*.—Stephens, 1852, List of the specimens of British animals in the British Museum, pt. 10, p. 16.

Peronea maccana.—Westwood, 1854, *in* Wood, Index entomologicus, ed. 2, p. 266, pl. 57, fig. 1768.—Stainton, 1859, Manual of British butterflies and moths, vol. 2, p. 253.—Wilkinson, 1859, British tortrices, p. 171.—Barrett, 1905, Lepidoptera of the British Islands, vol. 10, p. 226, pl. 453, fig. 2.—Meyrick, 1912, *in* Wagner, Lepidopterorum catalogus, pt. 10, p. 64; 1913, *in* Wytsman, Genera insectorum, fasc. 149, p. 63; 1927, Revised handbook of British Lepidoptera, p. 525.—Barnes and McDunnough, 1917, Check list of the Lepidoptera of Boreal America, p. 178, no. 7432.—Sheldon, 1919, The Ent., vol. 52, pp. 252–255 and 271–274; 1930, The. Ent., vol. 30, p. 222.—Pierce and Metcalfe, 1922, Genitalia of the group Tortricidae, p. 21, pl. 8 (female genitalia); 1935, Genitalia of the tineid families, p. 114, pl. 67.—?Forbes, [1924], Cornell Univ. Agr. Exp. Stat. Mem. 68, p. 486, 1923.—Filipjev, [1931], Ann. Mus. Zool. Acad. Sci. URSS., vol. 31, p. 302, 1930.—McDunnough, 1934, Canadian Journ. Res., vol. 11, pp. 292, 325 (fig. 2), 329 (fig. 2); 1939, Mem. Southern California Acad. Sci., vol. 2, p. 58, no. 7473; 1940, Canadian Ent., vol. 72, p. 59.—Lhomme, 1939, Catalogue des lépidoptères de France et de Belgique, vol. 2, p. 295.—Benander, 1950, Svensk Insektfauna, pt. 10, p. 13, fig. 3b.

Teras effractana (in part).—Walker, 1863, List of the specimens of lepidopterous insects in the British Museum, pt. 27, p. 206.

?*Tortrix repandana*.—Werneburg, 1864, Beiträge zur Schmetterlingskunde, vol. 1, pp. 467 and 561.

Teras fishiana Fernald, 1882, Trans. Amer. Ent. Soc., vol. 10, p. 66.

Teras fishian [sic].—Grote, 1882, New check list of North American moths, p. 57, no. 26.

Acalla maccana.—Meyrick, 1895, Handbook of British Lepidoptera, p. 523.—Rebel, 1901, *in* Staudinger and Rebel, Catalog der Lepidopteren des palaearctischen Faunengebietes, vol. 2, p. 81, no. 1149.—Kennel, 1908, Die palaearktischen Tortriciden, p. 74, pl. 4, fig. 17.—Benander, 1929, Ent. Tidskr., vol. 50, p. 136, figs. 9j–k; 1934, Ent. Tidskr. vol. 55, p. 123, pl. 1, fig. 3; 1940, Opuscula Ent. (Lund), vol. 5, p. 56.

Alceris [sic] *maccana*.—Fernald, [1903], U.S. Nat. Mus. Bull. 52, p. 474, no. 5311, 1902.

Alceris [sic] *fishiana*.—Fernald, [1903], U.S. Nat. Mus. Bull. 52, p. 475, no. 5321, 1902.

Peronea fishiana.—Meyrick, 1912, *in* Wagner, Lepidopterorum catalogus, pt. 10, p. 66; 1913, *in* Wytsman, Genera insectorum, fasc. 149, p. 64.—Barnes and McDunnough, 1917, Check list of the Lepidoptera of Boreal America, p. 178, no. 7437.—Forbes, [1924], Cornell Univ. Agr. Exp. Stat. Mem. 68, p. 483, 1923.—McDunnough, 1940, Canadian Ent., vol. 72, p. 59.

Acalla macana [sic].—Petersen, 1924, Lepidopteren-Fauna von Estland, p. 335.
Acleris maccana.—Obraztsov, 1955, Tijdschr. Ent., vol. 98, p. 193, fig. 357; 1956, Tijdschr. Ent. vol. 99, p. 149.

In his revision of the Canadian *Acleris* (=*Peronea*) species, McDunnough (1934) treated *fishiana* as a synonym of *maccana*, believing that "there are a few very slight, minor differences between the genitalia of European and North American specimens, but scarcely sufficient to warrant the retention of the name *fishiana* Fern. even in a varietal sense." In a more recent paper, McDunnough (1940) changed his opinion, and applied the name *fishiana* in a specific sense. For support of his new point of view, he compared the genitalia of North American specimens of *fishiana* with those of the European *maccana*, and found some differences, especially in the structure of the female genitalia. The most important difference consists of the length of the antrum which in *fishiana* extends over the cephalic margin of the sterigma, being in *maccana* shorter and not reaching this margin. Then, the caudal portion of the ductus bursae is in *fishiana* somewhat expanded, "being largely membranous with only indications of irregular chitinization," and not reaching the cephalic margin of the sterigma. A further difference, found by McDunnough, is the somewhat longer lateral lobes of the sterigma, which are in *fishiana* less outwardly oblique and have a small terminal spine. In the male genitalia, he noted that in *maccana* "the apical section of the tegumen shows a much narrower and shallower median excavation and the lateral flaps are less evident," and "the apical recurvation of the claspers is not so strong, resulting in a broader and shallower excavation of the ventral margin than is the case in *fishiana*." McDunnough emphasized that besides *fishiana* he also had from Canada three female specimens of the true *maccana* which agreed with the European specimens of this species. McDunnough was thus inclined to believe that both *fishiana* and *maccana* are represented in the Canadian fauna.

Because of the variation of the genitalia in the European specimens of *maccana* which show the same extremes as the characters described by McDunnough as typical of *fishiana*, the present author cannot subscribe to the opinion that *fishiana* and *maccana* are separate species. Owing to the transitional shape of the genitalia in certain specimens of *maccana*, it is impossible to recognize the above characters as constant for *fishiana*, the more so because even in the North American specimens this transition has been reported by the present author. A complete coincidence in the variation of the external characters of European and North American specimens confirms their conspecifity. The form *fishiana* corresponds to the nominate form of *maccana*, and falls as its synonym. Besides this form, two

more have been recorded for the Nearctic fauna, and they are inseparable from those known in Europe.

TYPES.—The type of *maccana* is not yet selected; it should originate from the "Böhmisch-Sächsische Grenze" (Bohemia and Saxony frontier), and is probably in the Budapest Museum. Type of *torquana*, male, "Dalecarl. Boh." ("Lappon.-Scania meridionalis"), in the Entomological Museum of the University of Lund, Sweden (cf. Benander, 1940, cited above). Lectotype of *fishiana* (selected by the present author), male, Orono, Maine, Sept. 17, 1879, USNM.

SPECIMENS EXAMINED.—One female (genitalia on slide, prepared by A. Busck, Feb. 22, 1924), Kaslo, British Columbia (H. G. Dyar), USNM; one female (genitalia on slide 414–Obr.), Winnipeg, Manitoba (A. W. Hanham), AMNH; two males and one female (genitalia on slides, prepared by A. Busck, June 28, 1920, and Jan. 8 and 18, 1924), Ottawa, Ontario, Sept. 5, 11, and 12, 1905 (C. H. Young), USNM.

Acleris maccana (Treitschke) form *suffusana* Sheldon

?*Peronea tristana*.—Westwood and Humphreys (not Hübner), 1845, British moths and their transformations, vol. 2, p. 159, pl. 94, fig. 13.

Acalla maccana (in part).—Kennel, 1907, *in* Spuler, Schmetterlinge Europas, vol. 2, p. 241, pl. 82, fig. 6; 1908, Die palaearktischen Tortriciden, p. 74, pl. 4, figs. 16 and 18.

Peronea maccana form *suffusana* Sheldon, 1930, The Ent., vol. 63, p. 223.

Acleris maccana aberration *suffusana*.—Obraztsov, 1956, Tijdschr. Ent., vol. 99, p. 149.

TYPE.—According to Sheldon (1930), the type of this form is figured by Kennel (1908, pl. 4, fig. 16); the original locality and the present location of the figured specimen are unknown.

SPECIMEN EXAMINED.—One male, Montreal, Quebec, Sept. 24, 1898 (Dietz), AMNH.

Acleris maccana (Treitschke) form *leporinana* Zetterstedt

Teras abietana (in part).—Fischer von Röslerstamn, 1837, Abbildungen zur Berichtigung und Ergänzung der Schmetterlingskunde, p. 69, pl. 34, fig. g.

Tortrix leporinana Zetterstedt, 1840, Insecta Lapponica, p. 980.

Teras maccana (in part).—Herrich-Schäffer, 1847, Systematische Bearbeitung der Schmetterlinge von Europa, vol. 4, Tortricides, pl. 3, fig. 16; 1851, Systematische Bearbeitung der Schmetterlinge von Europa, vol. 4, p. 149.

Teras lipsiana (in part).—Walker, 1863, List of the specimens of lepidopterous insects in the British Museum, pt. 27, p. 210.—Wocke, 1871, *in* Staudinger and Wocke, Catalog der Lepidopteren des europaeischen Faunengebiets, p. 234, no. 667.

Acalla maccana (in part).—Kennel, 1908, Die palaearktischen Tortriciden, p. 75, pl. 4, figs. 19–21.—Benander, 1940, Opuscula Ent., Lund, vol. 5, p. 53.

Peronea maccana form *canescana* Sheldon, 1930, The Ent., vol. 63, p. 223.

Peronea maccana.—Benander, 1950, Svensk Insektfauna, pt. 10, pl. 1, fig. 5.

Acleris maccana aberration *canescana*.—Obraztsov, 1956, Tijdschr. Ent., vol. 99, p. 149.

Acleris maccana aberration *leporinana*.—Obraztsov, 1956, Tijdschr. Ent., vol. 99, p. 149.

TYPES.—Type of *leporinana* is a specimen from "Abyn." ("Lapponia meridionalis"), in the Entomological Museum of the University of Lund, Sweden (cf. Benander, 1940, cited above). According to Sheldon (1930), the type of *canescana* is the specimen figured by Herrich-Schäffer (1847, pl. 3, fig. 16); the original locality and the present location of this specimen are unknown.

SPECIMEN EXAMINED.—One male, Winchendon, Mass., Oct. 20, 1902, AMNH.

Acleris nigrolinea (Robinson)

FIGURE 7,*a*; PLATES 5 (FIGS. 13–16), 11 (FIGS. 36–39)

Teras nigrolinea Robinson, 1869, Trans. Amer. Ent. Soc., vol. 2, p. 281, pl. 7, fig. 67.—Fernald, 1882, Trans. Amer. Ent. Soc., vol. 10, p. 6 (in part).—Grote, 1882, New check list of North American moths, p. 57, no. 7 (in part).—Klots, 1942, Bull. Amer. Mus. Nat. Hist., vol. 79, p. 414.

Alceris [sic] *nigrolinea*.—Fernald, [1903], U.S. Nat. Mus. Bull. 52, p. 473, no. 5305 (in part), 1902.

Peronea nigrolinea.—Meyrick, 1912, *in* Wagner, Lepidopterorum catalogus, pt. 10, p. 66; 1913, *in* Wytsman, Genera insectorum, fasc. 149, p. 64 (in part).—Barnes and McDonnough, 1917, Check list of the Lepidoptera of Boreal America, p. 178, no. 7435.—Forbes, [1924], Cornell Univ. Agr. Exp. Stat. Mem. 68, p. 484 (in part), 1923.—McDunnough, 1934, Canadian Journ. Res., vol. 11, p. 294; pp. 325 (fig. 3), 329 (fig. 5); 1939, Mem. Southern California Acad. Sci., vol. 2, p. 58, no. 7475.

The present information on this species is rather scanty. The original locality of the type specimen should be Grimsby, Ontario, although the lectotype of *nigrolinea*, selected by McDunnough (1934),

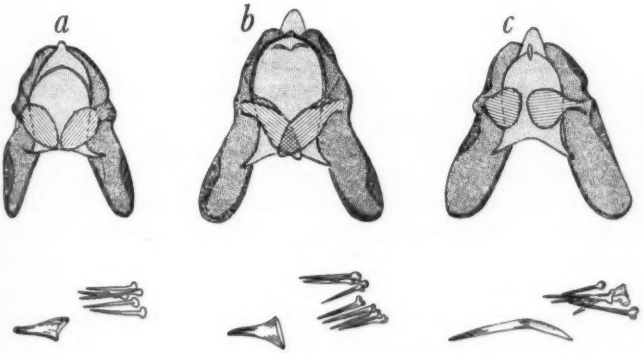

FIGURE 7.—Top portion of the male genitalia, above, and cornuti, below, of three *Acleris* species: *a*, *A. nigrolinea* (Robinson); *b*, *A. disputabilis*, new species; *c*, *A. maximana* (Barnes and Busck).

has no label with the data as to its origin. All specimens examined for the present paper were collected in Manitoba and Quebec, and there are some reasons to suppose that the range of *nigrolinea* is limited to the northeastern part of the Nearctic region. Earlier authors confused *senescens* Zeller and *nigrolinea*, which they treated as synonymous. Even Busck (1931) figured the female genitalia of *senescens* as those of *nigrolinea*. McDunnough (1934) first elucidated this problem, and described and figured correctly the genitalia of both sexes of these two species. On only one point the present author cannot agree with McDunnough, namely, in his treatment of *ferruginiguttana* Fernald as a variation of *nigrolinea*. This problem is discussed in detail in the section of the present paper dealing with the new species *disputabilis*.

TYPES.—Lectotype (selected by McDunnough, 1934), male (genitalia on slide 547–Obr.), no data (Grote and Robinson Collection); lectoparatype, no data (the same collection); both in AMNH.

OTHER SPECIMENS EXAMINED.—One male (without abdomen), Canada (erroneously labeled as "type"), in the Academy of Natural Sciences of Philadelphia. One female, Cartwright, Manitoba (E. F. Heath), USNM. One female (genitalia on slide 402–Obr.), Red Rock Lake, Whiteshell Forest Reserve, Manitoba, May 21, 1954 (C. D. Bird); nine males and five females (genitalia on slides 557–Obr., 559–Obr., 560–Obr., 564–Obr., and 565–Obr.), Aweme, Manitoba, Apr. 4, May 1, 1904; Oct. 19, 20, and 29, 1904; Mar. 24 and 25, Apr. 6, 7, 19, 21, and 26, 1905; Apr. 14–16, 1906 (N. Criddle); one female, Winnipeg, Manitoba (A. W. Hanham); one male (genitalia on slide 551–Obr.), St. Hilaire, Quebec, May 24; AMNH.

***Acleris disputabilis*, new species**

FIGURE 7,*b*; PLATES 6–7 (FIGS. 17–24), 12–14 (FIGS. 40–47)

Peronea nigrolinea var. *ferruginiguttana*.—McDunnough (not Fernald), 1934 Canadian Journ. Res., vol. 11, p. 294; 1939, Mem. Southern California Acad. Sci., vol. 2, p. 58, no. 7475a

Antennae more or less dark gray-brown, usually with white and black annulation basad. Head whitish gray to ochreous gray; as a rule, scales black checked at tips and (or) middle. Labial palpi externally concolorous with head, more or less black checked; internally whitish to pale ochreous. Thorax as head or darker, sometimes dark brown. Forewings whitish gray to ash gray or brownish, finely powdered with dark gray to blackish brown, and with many similarly colored tufts of raised scales. Some of these tufts arranged in numerous fine oblique transverse lines directed from costa externad. Or, forewings with a rather broad transverse fascia slightly behind middle, consisting of two or three dark gray spots confluent or sep-

arated, one of them at end of discal cell; often, a similarly colored tuft of raised scales basad and dorsad from this fascia, and another one between it and termen. Sometimes an ochreous ray along discal cell, interrupted at middle fascia and almost reaching termen. Sometimes some of veins darker than ground of forewings. Costa with dark gray spots; terminal line black, undulate. Above markings not present in each specimen, and varying in their development and combination. Cilia concolorous with ground of forewings, or somewhat paler. Under side of forewings more or less dark brownish gray, sometimes with whitish and blackish costal spots. Length of forewing, 11–14 mm. Hind wings pale fumose with grayish brown reticulation; cilia concolorous with ground or slightly paler with dark-gray basal line, sometimes with a dividing line.

MALE GENITALIA.—Tegumen slightly excavated at tip, without cristae; gnathos broad without any spiculation; socii decumbent, elongate, broadly lanceolate. Valvae narrowed apicad; brachiola rather large; sacculus drawn out into a more or less long acute or blunt point before half, sometimes with small additional thornlike projections before this point, then curving costad sharply and strongly, forming a large rotundate ventral excavation, and descending to a more or less sharply pointed tip directed downward; apical tuft moderate. Aedoeagus strongly curved, stout at base, then tapering; vesica with a cluster of four to eight cornuti capitate at base, and a stout robust thornlike apical cornutus dilated basad.

FEMALE GENITALIA.—Sterigma with strongly dilated, then tapering lateral lobes with tipes more or less acute and usually curved. Antrum wide and long, bifurcate cephalad, sclerotized especially caudad. Ductus bursae slightly longer than cervix bursae, almost as broad as antrum, somewhat narrowed cephalad. Cervix bursae moderate, broader than adjacent part of ductus; corpus bursae rotundate or slightly ovate; signum stellate, scobinate.

TYPES.—Holotype, male (genitalia on slide, prepared by A. Busck, Sept. 6, 1923), Goldstream, British Columbia, Oct. 16, 1902; allotype, female (genitalia on slide, prepared by A. Busck, Aug. 20, 1923), Wellington, British Columbia, Mar. 29, 1903; one male paratype (genitalia on slide, prepared by A. Busck, Jan. 21, 1924), Duncans, Vancouver Island, British Columbia, Sept. 17, 1913 (A. W. Hanham); all three specimens in USNM. Paratypes: one male (genitalia on slide 566–Obr.), Victoria, British Columbia, April 15, 1910 (A. J. Croker); one female (genitalia on slide 563–Obr.), the same locality, Nov. 22 (A. W. Hanham); AMNH.

Other specimens examined: One female (genitalia on slide, prepared by A. Busck, Oct. 16, 1924), Hymers, Ontario, April, USNM. One male (genitalia on slide 540-Obr.), Satus Creek, 10 miles from

Toppenish, Wash., Apr. 14, 1956 (A. I. Good); one male (genitalia on slide 391-Orb.), Spring Creek, 4000 ft., near Baker, Baker County, Ore., May 7, 1953 (J. H. Baker); one female (genitalia on slide 561-Obr.), San Mateo, Calif., Mar. 6, 1942 (G. E. Pollard); one female (genitalia on slide 562-Obr.), Sierra Nevada, Calif.; one female (genitalia on slide 558-Obr.), Fort Collins, Colo., Aug. 12, 1898 (Kearfott Collection); one female (genitalia on slide 553-Obr.), Salida, Colo., Apr. 7, 1888 (Hulst Collection); all in AMNH. Three females (genitalia of two of them on slides: one prepared by A. Busck, Nov. 14, 1924; the other, no. 1-Obr., Nov. 2, 1959), Salida, Colo., Apr. 7, 1888, and Apr. 4 and 6, 1889 (W. S. Foster; Fernald Collection); one male (genitalia on slide, prepared by A. Busck, Nov. 13, 1924), no data (Fernald Collection); one female (genitalia on slide 2-Obr., Nov. 2, 1959), Jemez Springs, N. Mex., Apr. 8, 1915; the five specimens in USNM.

REMARKS.—This is the species which the late A. Busck was inclined to identify with *Teras ferruginiguttana* Fernald (cf. McDunnough, 1934, p. 294). At the time when Busck wrote McDunnough about his conception of *ferruginiguttana*, the unique female type of this species was already nonexistent and was represented only by some few fragments useless for any diagnostic purpose. In this poor condition this type is now deposited at the United States National Museum, and the present author can describe it as a small portion of thorax with one of the hind legs and basal part of a hind wing. The only information upon the type of *ferruginiguttana* is in the original description of this species (Fernald, 1882, p. 65). This description gives some reasons to suppose in *ferruginiguttana* a species related to *maximana* and *nigrolinea*, but it is also quite possible that *ferruginiguttana* might belong to some other group. None of the specimens, identified by Busck as *ferruginiguttana* and deposited at the U.S. National Museum, correspond completely to the original description of this species which should have in the forewings "a tuft on the fold near the base of the wing, an elongated streak through the oblique stripe on the cell, and a spot between this and the outer border, bright rust-red." Busck himself was probably not quite convinced of his conception of *ferruginiguttana*, and there is in the above collection only one female specimen from Colorado with Busck's authentic label on the pin, reading "*P. ferruginiguttana* Fern." Some other specimens have this name on the genitalia slides only, and it is always written by Busck in pencil and usually accompanied by a question mark. Moreover, *ferruginiguttana* appears on these slides as a second name, the first one, written in India ink, being "*Peronea maximana*." In his unpublished manuscript notes of October 1919, Busck wrote: "7438. *P. ferruginiguttana* Fernald. Colorad[o]. 28 mm. *Our largest described species.*

Unfi[?ttingly] desc[ribed] from a *unique female!* Gray with rust-red streak on cell a[nd] tuft on fold. Not represented in B.[arnes] coll[ection] an[d] I cannot id[e]nt[i]fy it as any of the large Northwest specim[ens] [from] B.[ritish] C.[olumbia] which I shall descr[i]be as [a] *n.*[ew] *sp.*[ecies]."

Thus, there is no other choice but to treat *ferruginiguttana* as a "species dubia" without any definitive diagnosis. Any attempt to apply this name to some *Acleris* specimens would merely be based on a simple speculation which might be rejected by later authors. Since the type specimen of *ferruginiguttana* is destroyed, and therefore its genitalia cannot be studied, it seems safer to recognize this name as unavailable for systematic use. For this reason, the present author has decided to propose for the species treated, without proof, by Busck and McDunnough as Fernald's *ferruginiguttana*, the name *disputabilis*, new species.

McDunnough (1934) regarded the specimens of this species, occurring in the western Canadian provinces, as agreeing in genitalia with those from Colorado, identified by Busck with *ferruginiguttana*, and used this latter name in a varietal sense, for a form of *nigrolinea*. The specimens from Manitoba, Alberta, and British Columbia McDunnough believed to belong to this variety, whereas the specimens from Ontario he referred to the nominate form of *nigrolinea*. On the basis of an essential material, the present author has established genitalic differences between the specimens from British Columbia and Manitoba, and he can only identify those from British Columbia with his new species *disputabilis* (*ferruginiguttana* Busck and McDunnough, not Fernald). He has found the specimens from Manitoba inseparable from *nigrolinea*.

It is quite difficult, if not impossible, to recognize *disputabilis* on the basis of its external characters. The color of forewings and their markings vary so much in this new species that some specimens can easily be confused with *nigrolinea* or *maximana*. Only the genitalia give a basis for separation. In their general shape the male genitalia of *disputabilis* resemble those of *nigrolinea*, but differ from them in some details. The socii of *disputabilis* are somewhat longer than in *nigrolinea*, and are distinctly tapering apicad. The angle of sacculus before its half is prolonged in a stouter thornlike projection than in *nigrolinea*, in which this projection is slightly bent upward. The excavation of sacculus externad from this projection is in *disputabilis* somewhat deeper, and the tip of sacculus is longer than in *nigrolinea* and ends more acutely. In general, the valva of *disputabilis* is more downcurved than in *nigrolinea*. In the female genitalia, *disputabilis* differs from *nigrolinea* in having the lateral lobes of sterigma much

broader and less tapering, and the antrum somewhat broader and longer. The difference between *disputabilis* and *maximana* is more remarkable: The gnathos of the new species has no spiculation, the socii are longer and of a distinctly other shape, the valva is more downcurved, the external excavation of sacculus is narrower, and the apical cornutus of the vesica has a flat base. The lateral lobes of sterigma of *disputabilis* are more rotundate apicad, and they usually are more bent than in *maximana*.

The variation of external characters of *disputabilis* is very large, but the present knowledge of it is inadequate for separation of geographic forms. The range of this western Nearctic species is probably limited by the Rocky Mountains, although in Canada *disputabilis* is known from one female specimen from east of this line, in Ontario.

Acleris maximana (Barnes and Busck), new combination

FIGURE 7,*c*; PLATES 8 (FIGS. 25–28), 15–18 (FIGS. 48–60)

Peronea maximana Barnes and Busck, 1920, Contr. Nat. Hist. Lep. North America, vol. 4, p. 216, pl. 32, fig. 1.—Blackmore, 1921, British Columbia Prov. Mus. Rept. for 1920, pp. 24 and 28, pl. 2.—McDunnough, 1934, Canadian Journ. Res., vol. 11, pp. 295, 325 (fig. 4), 329 (fig. 6); 1939, Mem. Southern California Acad. Sci., vol. 2, p. 58, no. 7476.

Peronea maxima [sic].—Heriot, 1935, Proc. Ent. Soc. British Columbia, vol. 31 (for 1934), p. 32.

McDunnough (1934) gave a quite accurate redescription of average specimens of *maximana*, but it does not completely cover the variation of this species. The ground color of the forewings varies from whitish gray and bluish gray to smoky gray or brownish gray. Some specimens have the forewings with markings rather complete, but in others these markings are obliterate or lacking; in some, dark gray spots are present. The spots, situated before the last third of the forewing, sometimes form a kind of interrupted transverse fascia. A dark spot on discocellulars in often developed. In some specimens the forewings are dark sprinkled or reticulated, in others they are strigate because of dark lines on veins. Along the discal cell of the forewings a yellowish ray is sometimes present which reaches almost to the termen below apex. Hind wings are whitish, more or less smoky, often with fine dark reticulation. The above variation obscures any constant characters distinguishing *maximana* from *nigrolinea* Robinson and *disputabilis*, new species. As discussed above under *disputabilis*, the genitalia give, in spite of their variation, a basis for separating these three species. In the male genitalia, this variation is seen in the shape of the valvae. The angle of the sacculus before half is either produced into a rather acute or blunt point, or it is simply rounded. The number of cornuti in the group varies from five to eight.

TYPE.—Holotype, male (genitalia on slide, prepared by A. Busck, Oct. 4, 1919), Victoria, British Columbia, Sept. 16, 1909 (A. J. Croker), USNM.

OTHER SPECIMENS EXAMINED.—Five males (genitalia of three on slides, prepared by A. Busck, Sept. 27, 1923, and Jan. 7 and 8, 1924), Rampart, Alaska; one female (genitalia on slide, prepared by A. Busck, Jan. 11, 1924), Duncans, Vancouver Island, Apr. 18, 1908 (A. W. Hanham); one female (genitalia on slide, prepared by A. Busck, Sept. 14, 1923), Quamichan Lake, Vancouver Island, Apr. 4, 1916; one male (genitalia on slide, prepared by A. Busck, Oct. 10, 1923), Fraser Mills, British Columbia, Sept. 11, 1921 (L. E. Marment); two females (genitalia on slides, prepared by A. Busck, Sept. 5, and Nov. 8, 1923), Wellington, British Columbia, no date (R. V. Harvey) and Mar. 24, 1903; all in USNM. Three males and three females (genitalia of all males and one female on slides 539-Obr., 548-Obr., 544-Obr., and 568-Obr.), Wellington, British Columbia, Mar. 28, 1903, and April (G. W. Taylor); one male (genitalia on slide 554-Obr.), Robson, British Columbia, May 2, 1938; specimens in AMNH. One male (genitalia on slide, prepared by A. Busck, Oct. 16, 1924), Hymers, Ontario, USNM. One female (genitalia on slide 424-Obr.), Spring Creek, 4000 ft., near Baker, Baker County, Oreg., June 10, 1953 (J. H. Baker); one male (genitalia on slide 552-Obr.), Wagon Camp, Mount Shasta, Calif., June 12, 1939 (collection of G. H. and J. L. Sperry); one male and one female (genitalia on slides 542-Obr. and 567-Obr.), Sierra Nevada, Calif.; specimens in AMNH. One female (genitalia on slide, prepared by A. Busck, Oct. 4, 1924), Plumas County, Calif., Apr. 16–23; one female, Fallen Leaf Lake, Calif., Sept. 27, 1932 (H. H. Keifer); one male (genitalia on slide, prepared by J. K., Oct. 1, 1924), Glenwood Springs, Colo., Apr. 20, 1895 (W. Barnes); specimens in USNM. One male (genitalia on slide 556-Obr.), Glenwood Springs, Colo., one male (genitalia on slide 185-Obr.), near Alpine Ranger Station, 9500–13000 ft., Gunnison County, Colo., July 5, 1957 (F. and P. Rindge); specimens in AMNH. One male (genitalia on slide, prepared by A. Busck, Aug. 22, 1938), campus, Utah State Agricultural College, Logan, Utah, at light, Apr. 13, 1935 (G. F. Knowlton), USNM. One male (genitalia on slide 569-Obr.), New York (G. D. Hulst Collection); one male (genitalia on slide 534-Obr.), Pennsylvania (G. D. Hulst Collection); specimens in AMNH.

FOOD PLANTS.—*Populus balsamifera* and apple (McDunnough, 1934); *Prunus emarginata*, according to data on specimen from Fallen Leaf Lake, Calif.

***Acleris emargana blackmorei*, new subspecies**

Rhacodia effractana.—Walsingham, 1879, Illustrations of typical specimens of Lepidoptera Heterocera, pt. 4, p. 76.

Teras effractana.—Fernald, 1882, Trans. Amer. Ent. Soc., vol. 10, p. 5.—Grote, 1882, New check list of North American moths, p. 57, no. 1.—Moffat, 1891, Canadian Ent., vol. 23, p. 168.

Alceris [sic] *effractana.*—Fernald, [1903], U.S. Nat. Mus. Bull. 52, p. 472, no. 5299, 1902.

Peronea caudana.—Meyrick, 1912, *in* Wagner, Lepidopterorum catalogus, pt. 10, p. 59; 1913, *in* Wytsman, Genera insectorum, fasc. 149, p. 61.—Barnes and McDunnough, 1917, Check list of the Lepidoptera of Boreal America, p. 178, no. 7412.

Peronea emargana.—McDunnough, 1934, Canadian Journ. Res., vol. 11, pp. 291, 325 (fig. 1), 329 (fig. 1); 1939, Mem. Southern California Acad. Sci., vol. 2, p. 58, no. 7472.

Acleris emargana (in part).—Obraztsov, 1956, Tijdschr. Ent., vol. 99, p. 151.

MALE.—Forewings dark gray brown to ruddy brown, usually with a more or less wide, reddish area near tornus; costa with a very flat excavation. Length of forewing, 8–11 mm.

FEMALE.—Similar to male, but excavation of costa of forewings deeper.

TYPES.—Holotype, male (genitalia on slide, prepared by A. Busck, Mar. 3, 1924), Goldstream, British Columbia, Aug. 7, 1923 (E. H. Blackmore); allotype, female, the same data, Aug. 6, 1923. In USNM (no. 65591).

PARATYPES.—British Columbia: four males and four females (genitalia of one male on slide, prepared by A. Busck, Mar. 4, 1924), Goldstream, Sept. 5, 1920, and Aug. 6–7, 1923 (E. H. Blackmore); one male and four females (genitalia of three females on slides, prepared by A. Busck, Mar. 1 and 2, 1924, and Nov. 9, 1923), Victoria, Sept. 9, 1920, Sept. 2, 1921, and Aug. 24, and Sept. 8, 1922 (E. H. Blackmore); one male, the same locality, July 26, 1922 (W. R. Carter); two males (genitalia of one on slide 557, prepared by C. Heinrich), Kaslo, July 25, 1894, and May 20, 1899 (H. G. Dyar); all the above paratype specimens in USNM; one male, Vancouver Island, AMNH. Ontario: one male, Ottawa, Aug. 5, 1905 (C. H. Young), AMNH. Washington: two males (genitalia of one on slide 735, prepared by J. F. Gates Clarke, Nov. 7, 1934), Toad Lake, Whatcom County, Sept. 3, 1929 (J. F. Gates Clarke); one male, Bellingham, Whatcom County, July 25, 1923 (J. F. Gates Clarke); one male and one female, Lake Ballinger, Snohomish County, Aug. 19, 1930 (T. C. and J. F. Gates Clarke); all the above specimens from the State of Washington; in USNM.

REMARKS.—This subspecies is named for E. H. Blackmore. The name has been adapted from labels on genitalia slides prepared by A. Busck who considered *blackmorei* to be a separate species. There

is no reason to follow this point of view, because the genitalia of North American specimens do not differ from those of the European moths. Inasmuch as the North American specimens of *emargana* have a flatter excavation of the costa of the forewings in males than the European aberration *caudana* Fabricius of this species, the present author believes that it is reasonable to distinguish them as a separate subspecies. The general appearance of *blackmorei* is very similar to that of the European *caudana*.

In the U.S. National Museum there is a single female from Brackenridge, Colo., taken in June by Oslar (genitalia on slide 1-Obr., Jan. 9, 1959). It differs in the color of forewings from the remaining specimens known from North America, and reminds one rather of the European aberration *scabrana* Fabricius of *emargana*. Until further specimens of this color form are known in this country, its systematic position cannot be ascertained.

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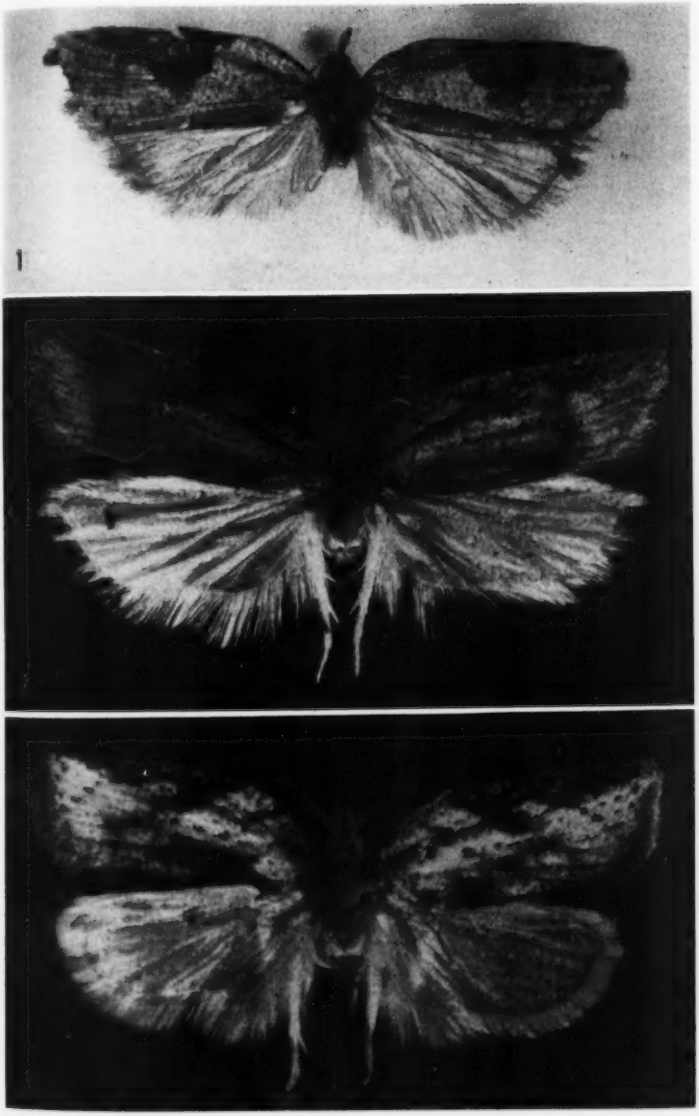
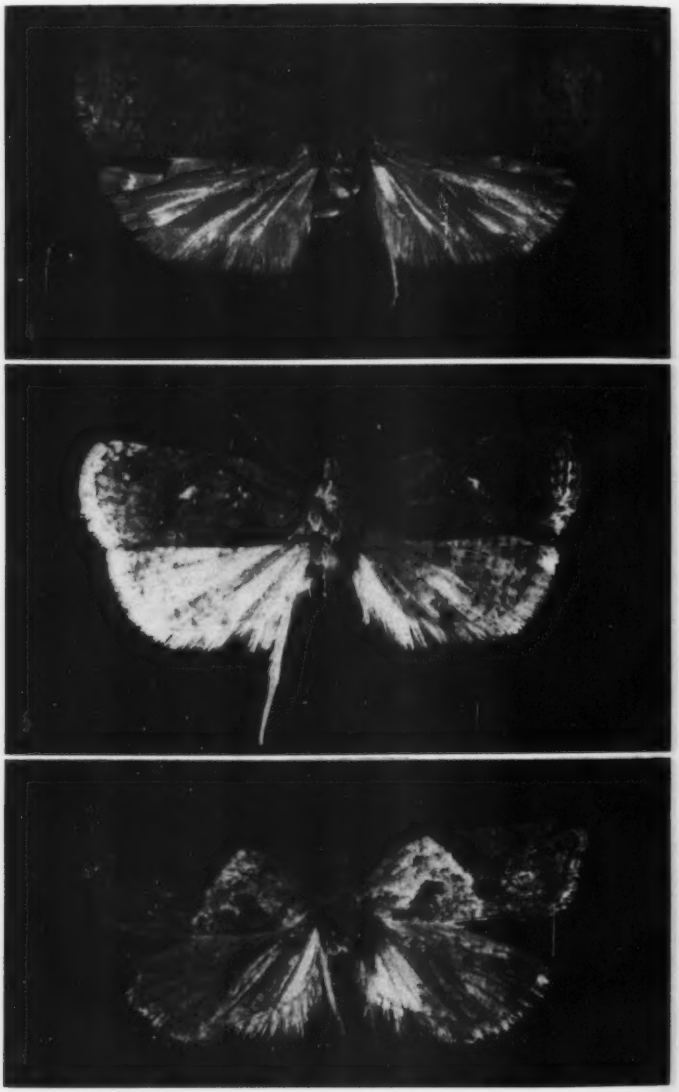
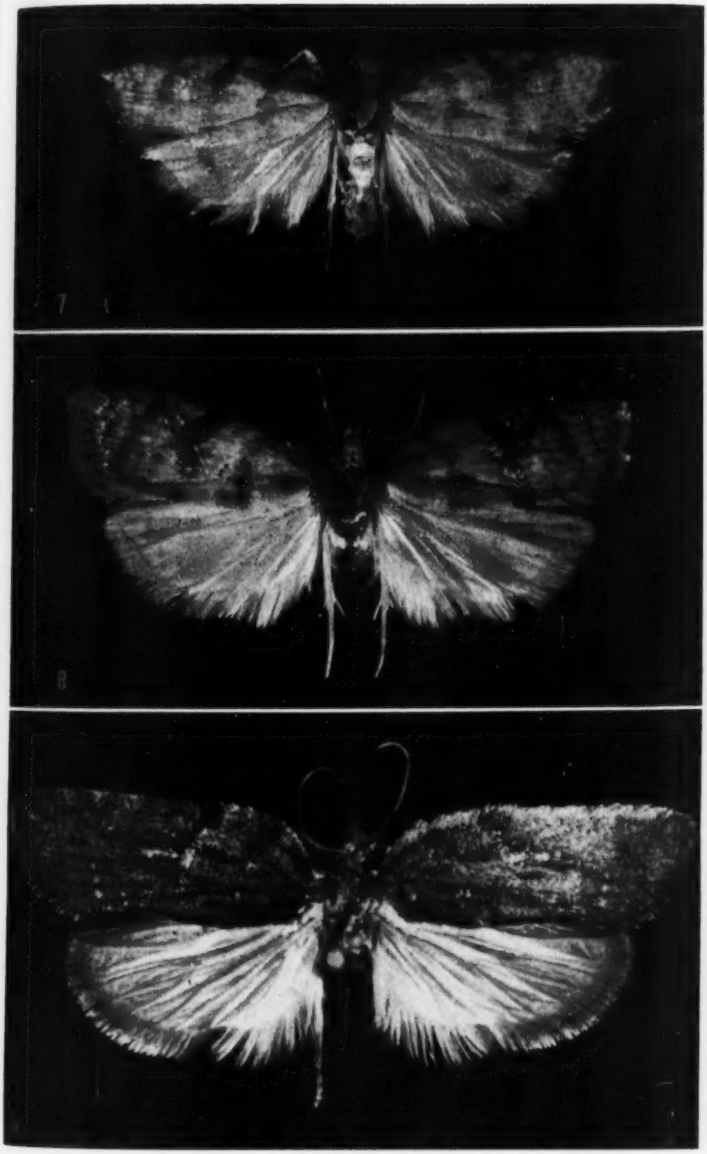


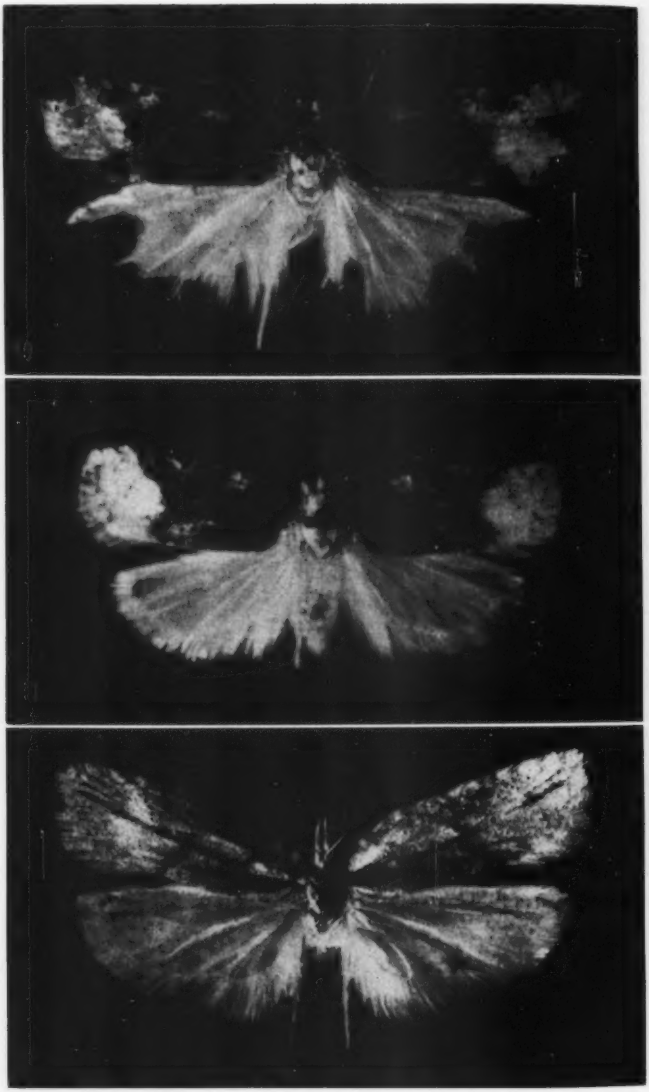
FIGURES 1–3.—*Acleris* species: 1, *A. macdunnoughi*, new species, holotype ♀, Winchendon, Mass., Sept. 29, 1902; USNM. 2, *A. capizziana*, new species, allotype ♂, Bendon, Oreg., Sept. 24, 1956 (J. Capizzi); USNM. 3, *A. capizziana*, new species, holotype ♀, Bendon, Oreg., Sept. 24, 1956 (J. Capizzi); USNM.



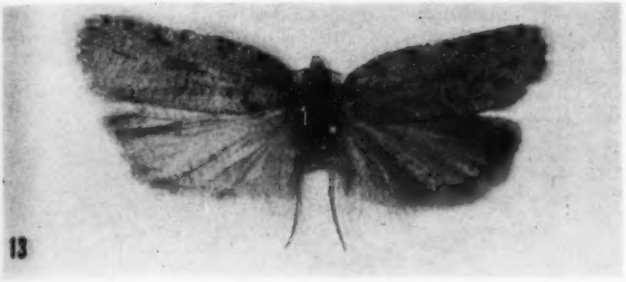
FIGURES 4–6.—*Acleris* species: 4, *A. santacrucis*, new species, holotype ♂, Santa Cruz, Calif., Oct. 29, 1932 (Tilden); USNM. 5, *A. britannia* Kearfott, form *b*. ♀, Biological Station, Departure Bay, British Columbia, Aug. 5, 1909 (A. W. Hanham); USNM. 6, *A. britannia* Kearfott, form *a*. ♂, Puyallup, Pierce County, Wash., Aug. 20, 1930 (T. C. Clarke); USNM.



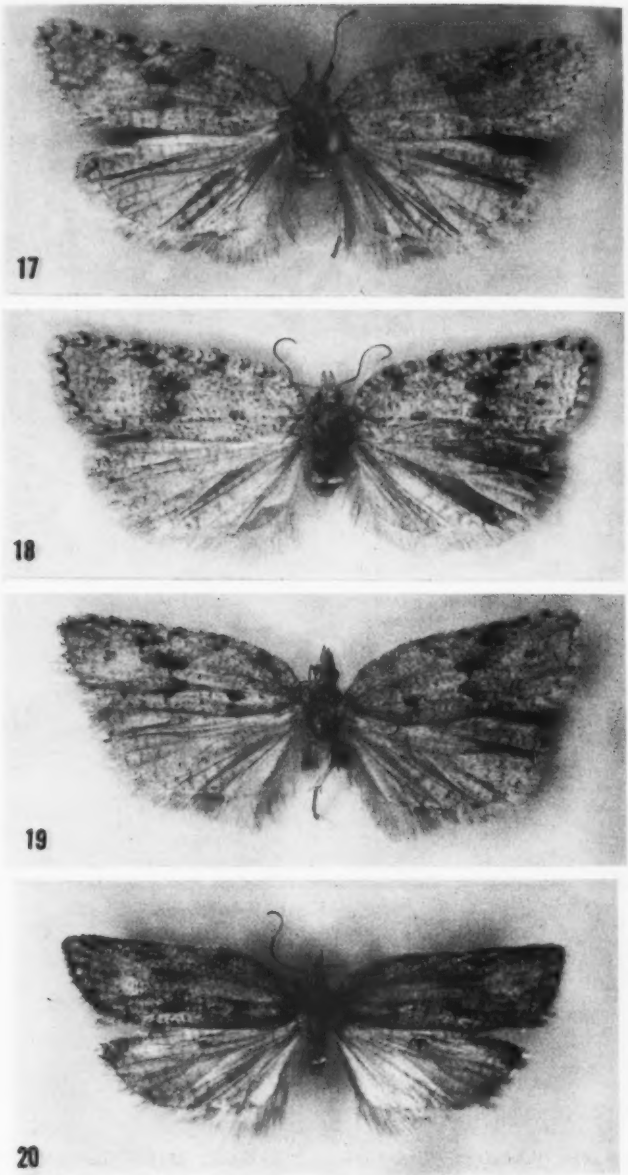
FIGURES 7–9.—*Acleris* species: 7, *A. klotsi*, new species, holotype ♂, Ramsay Canyon, Huachuca Mountains, Ariz., July 10–15, 1941 (A. B. Klots); AMNH. 8, *A. klotsi*, new species, allotype ♀, Ramsay Canyon, Huachuca Mountains, Ariz., July 10–15, 1941 (A. B. Klots); AMNH. 9, *A. incognita*, new species, holotype ♀, Moscow Mountains, Idaho, Aug. 7, 1933 (J. F. Gates Clarke); USNM.



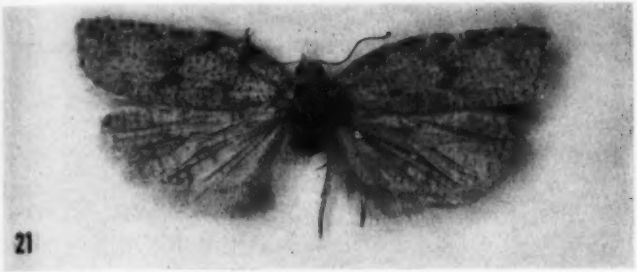
FIGURES 10–12.—*Acleris* species: 10, *A. clarkei*, new species, holotype ♂, Cle Elum, Kittitas County, Wash., Apr. 9, 1931 (J. F. Gates Clarke); USNM. 11, *A. clarkei*, new species, allotype ♀, Aweme, Manitoba, Apr. 18, 1905 (N. Criddle); USNM. 12, *A. senescens* (Zeller), variety. ♂, Half Moon Bay, Calif., Feb. 6, 1940 (W. H. Lange); USNM.

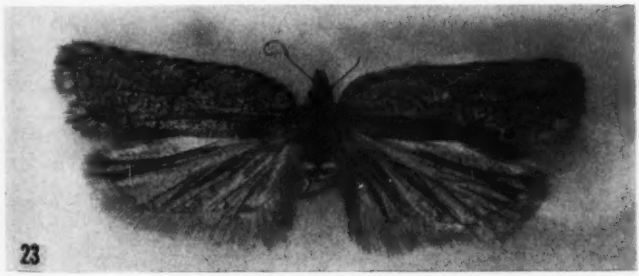


FIGURES 13–16.—*Acleris nigrolinea* (Robinson): 13, Lectotype ♂, no data; AMNH. 14, Genitalia of the lectotype (slide 547–Obr.). 15, ♂, Aweme, Manitoba, Oct. 20, 1904 (N. Criddle); AMNH. 16, ♂, St. Hilaire, Quebec, May 24; AMNH.

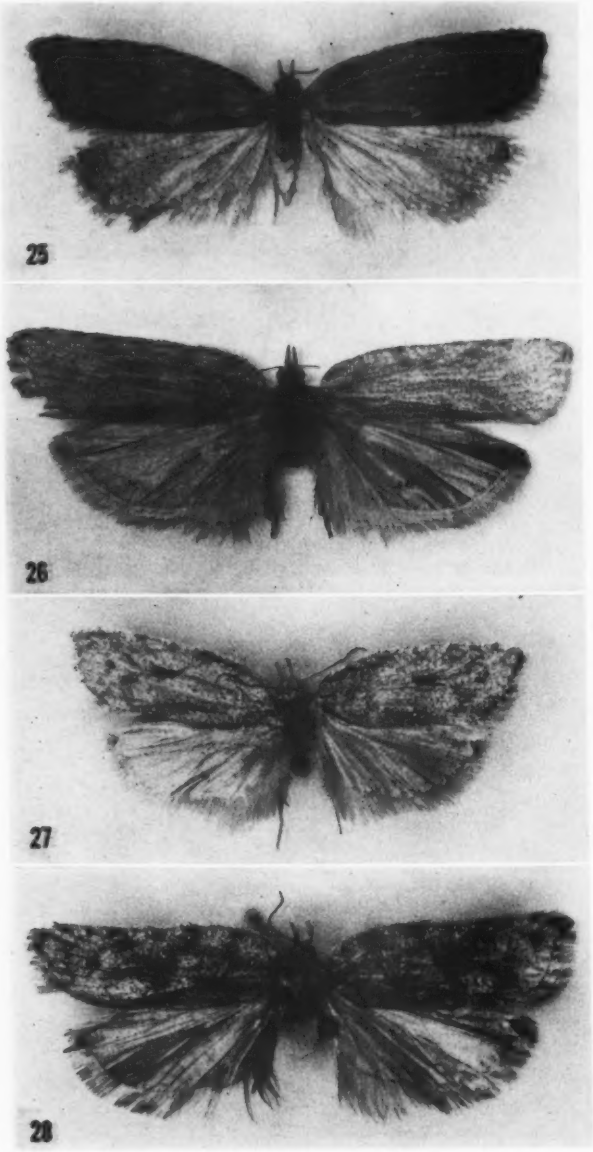


FIGURES 17–20.—*Acleris disputabilis*, new species: 17, Holotype ♂, Goldstream, British Columbia, Oct. 16, 1902; USNM. 18, Paratype, ♂, Duncans, Vancouver Island, British Columbia, Sept. 17, 1913 (A. W. Hanham); USNM. 19, Paratype, ♂, Victoria, British Columbia, Apr. 15, 1910 (A. J. Croker); AMNH. 20, ♂, Spring Creek, 4000 ft., near Baker, Baker County, Oreg., May 7, 1953 (J. H. Baker); AMNH.





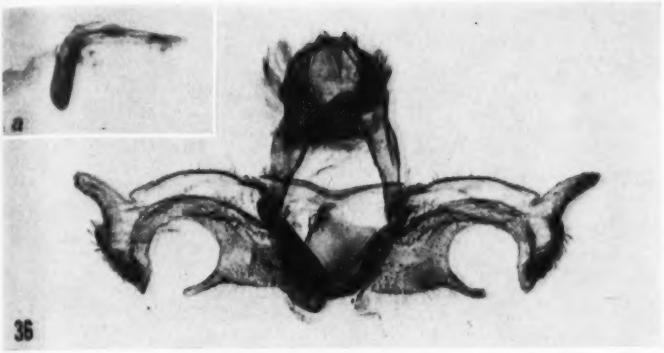
FIGURES 21–24—*Acleris* species: 21–23, *A. disputabilis*: 21, ♀, San Mateo, Calif., Mar. 6, 1942 (G.E. Pollard); AMNH; 22, ♀, Hymers, Ontario, April; USNM; 23, ♀, Salida, Colo., Apr. 7, 1888; AMNH. 24, Species near *A. disputabilis*, ♀, Southwestern Research Station of the American Museum of Natural History, 5400 ft., 5 miles west from Portal, Cochise County, Ariz., Mar. 31, 1956 (Cazier and Ordway); AMNH.

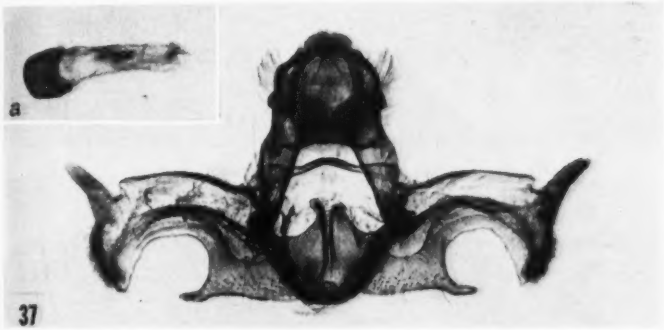


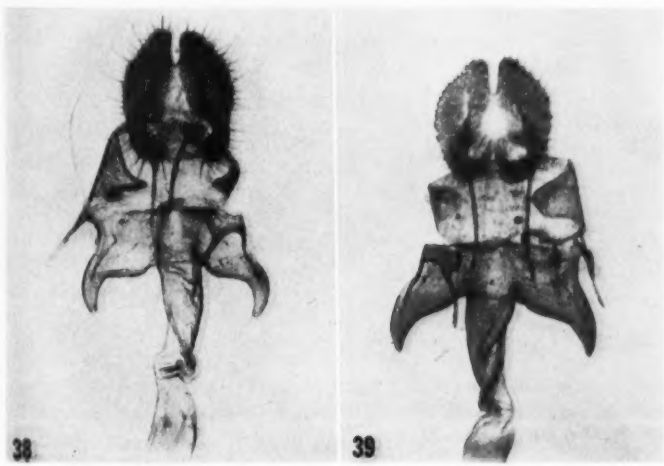
FIGURES 25–28.—*Acleris maximana* (Barnes and Busck): 25, ♂, Robson, British Columbia, May 2, 1938; AMNH. 26, ♂, Glenwood Springs, Colo.; AMNH. 27, ♀, Quamichan Lake, Vancouver Island, British Columbia, Apr. 4, 1916; USNM. 28, ♀, Plumas County, Calif., Apr. 16–23; USNM.

FIGURES 29–31.—Male genitalia of *Acleris* species: 29, *A. santacrucis*, new species, holotype (slide prepared by A. Busck on Feb. 10, 1933) (see pl. 2, fig. 4). 30, *A. walkerana* McDunnough). Western Greenland, 69°45′ E., Aug. 22–25, 1949 (Mission P. E. Victor H. de Lesse, 1949); slide 1–Obr.; Muséum National d'Histoire Naturelle. 31, *A. gloverana* (Walsingham). Holotype, Sheep Rock, Siskiyou County, Calif., Sept. 3, 1871 (Walsingham); slide 5353; BM.

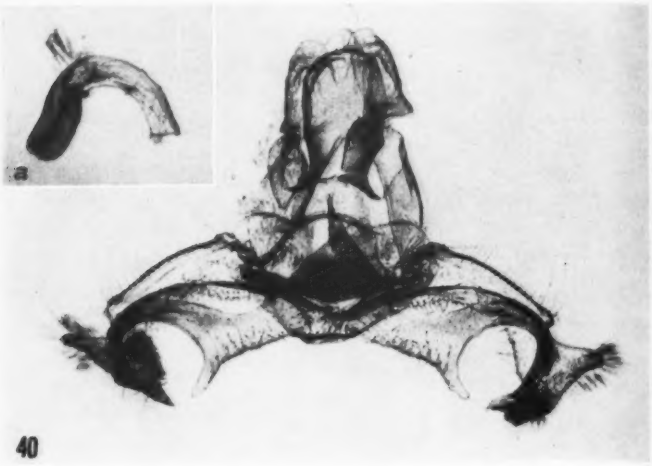
FIGURES 32–35.—Female genitalia of *Acleris* species: 32, *A. santacrucis*, new species, allotype (slide 1–Obr., Jan. 28, 1959), Santa Cruz, Calif., Oct. 29, 1932 (Tilden); USNM. 33, The above, detail of caudal part. 34, *A. implexana* (Walker), holotype (slide 5355), St. Martins Falls, Albany River, Hudsons Bay, Canada, 1844 (Barnston); BM. 35, *A. walkerana* (McDunnough). Western Greenland, 69°45′ E., Aug. 22–25, 1949 (Mission P. E. Victor H. de Lesse, 1949); slide 2–Obr.; Muséum National d'Histoire Naturelle.

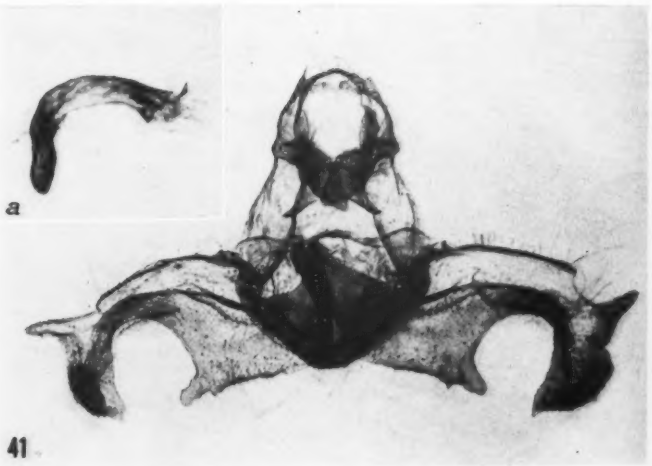




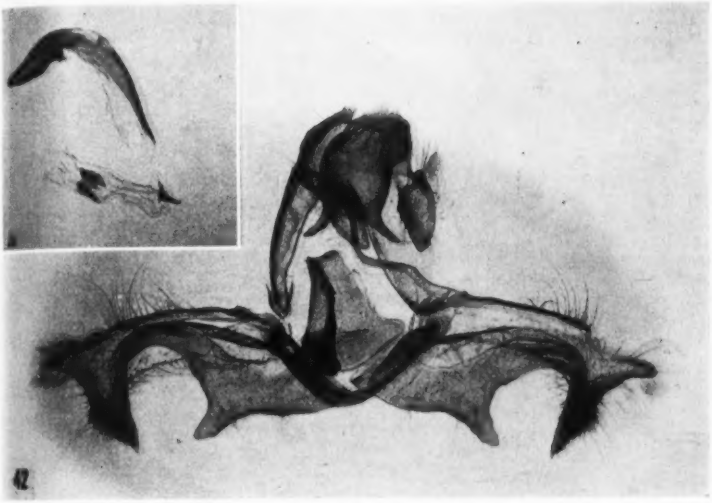


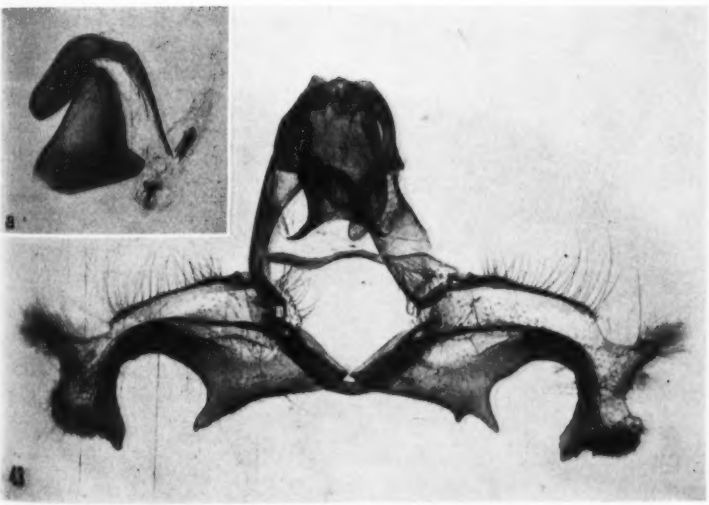
FIGURES 36–39.—Genitalia of *Acleris nigrolinea* (Robinson): 36, ♂ (slide 565–Obr.), Aweme, Manitoba, Apr. 4, 1904 (N. Criddle); AMNA. 37, ♂ (slide 564–Obr.), Aweme, Manitoba, Oct. 19, 1904 (N. Criddle); AMNH. 38, ♀ (slide 557–Obr.), Aweme, Manitoba, Mar. 25, 1905 (N. Criddle); AMNH. 39, ♀ (slide 559–Obr.), Aweme, Manitoba, Apr. 26, 1905 (N. Criddle); AMNH.



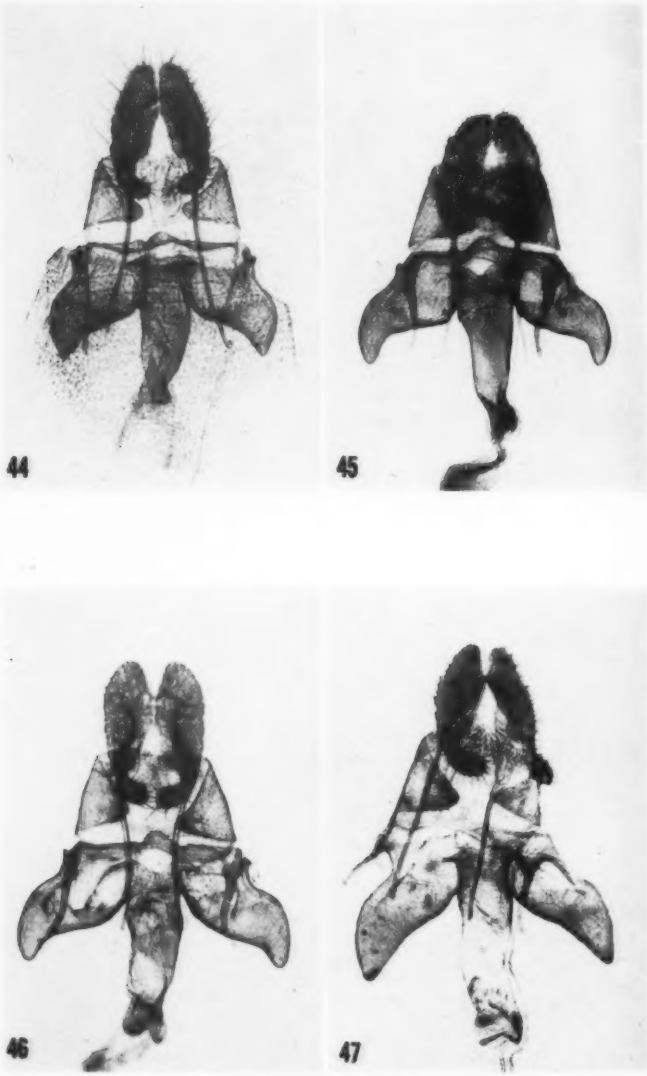


FIGURES 40, 41.—Male genitalia of *Acleris disputabilis*, new species: 40, Satus Creek, 10 miles from Toppenish, Wash., Apr. 14, 1956 (A. I. Good); slide 540–Obr.; AMNH. 41, Slide 391–Obr. (see pl. 6, fig. 20).



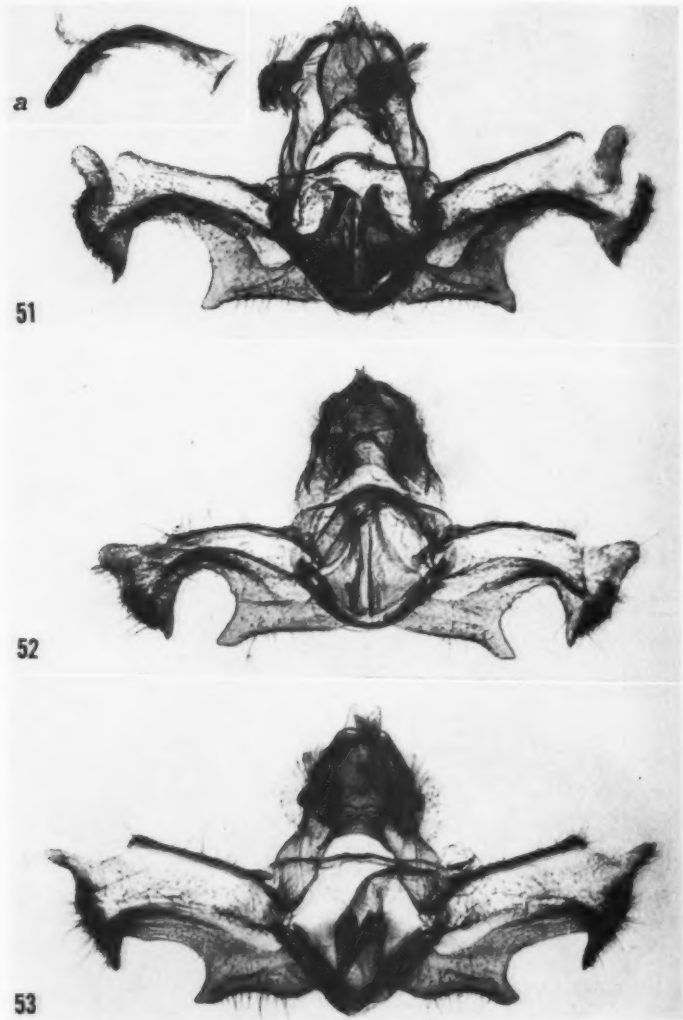


FIGURES 42, 43.—Male genitalia of *Acleris disputabilis*, new species: 42, Slide prepared by A. Busck, Jan. 21, 1924 (see pl. 6, fig. 18). 43, No data; slide prepared by A. Busck, Nov. 13, 1924; USNM.

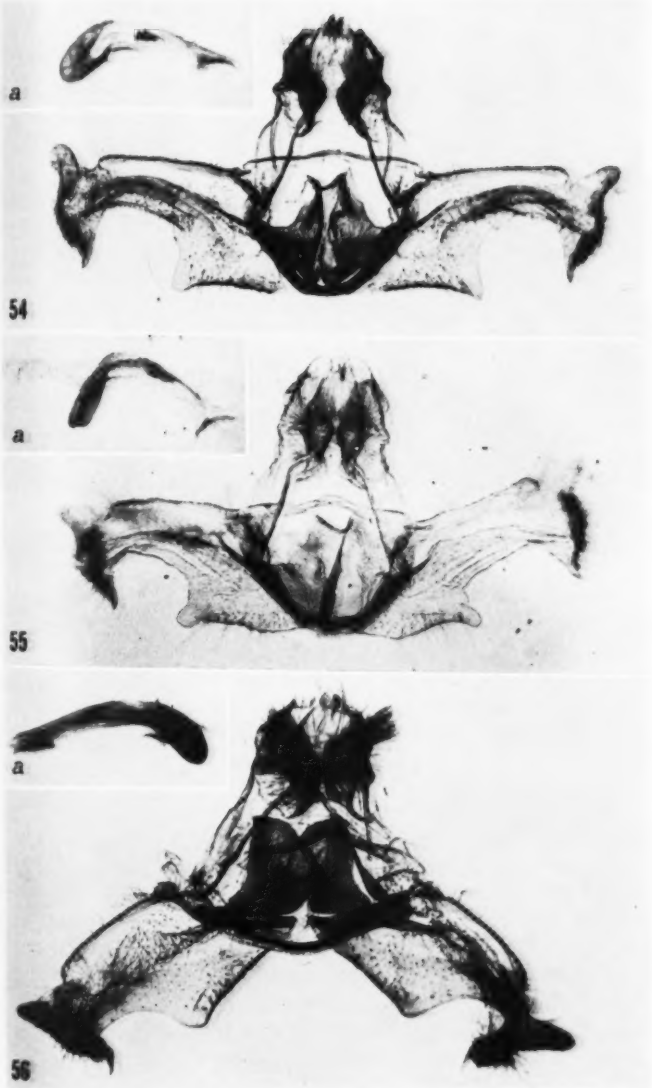


FIGURES 44–47.—Female genitalia of *Acleris disputabilis*, new species: 44, Salida, Colo. (W. S. Foster); slide prepared by A. Busck, Nov. 14, 1924); USNM. 45, Slide 553–Obr. (see pl. 7, fig. 23). 46, Jemez Springs, N. Mex., Apr. 8–15; slide 2–Obr., Nov. 2, 1959, USNM. 47, Paratype, Victoria, British Columbia, Nov. 22 (A. W. Hanham); slide 563–Obr.; AMNH.

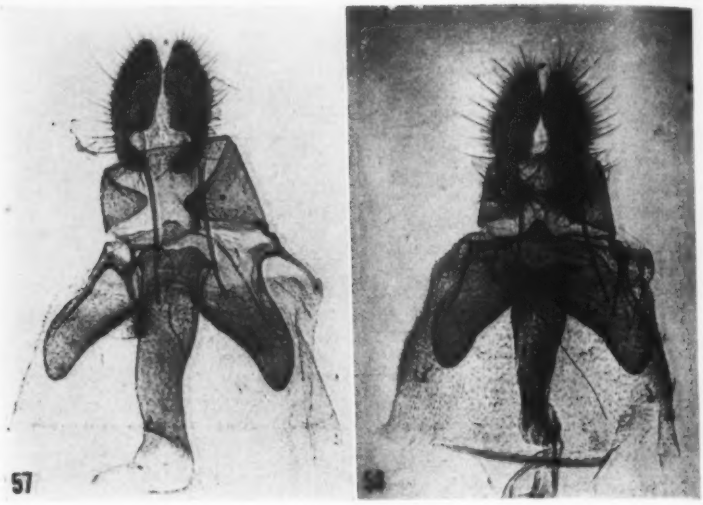
FIGURES 48–50.—Male genitalia of *Acleris maximana* (Barnes and Busck): 48, Slide 556–Obr. (see pl. 8, fig. 26). 49, Sierra Nevada, Calif.; slide 542–Obr.; AMNH. 50, Near Alpine Ranger Station, 9,500–13,000 ft., Gunnison County, Colo., July 5, 1957 (F. and P. Rindge); slide 185–Obr.; AMNH.

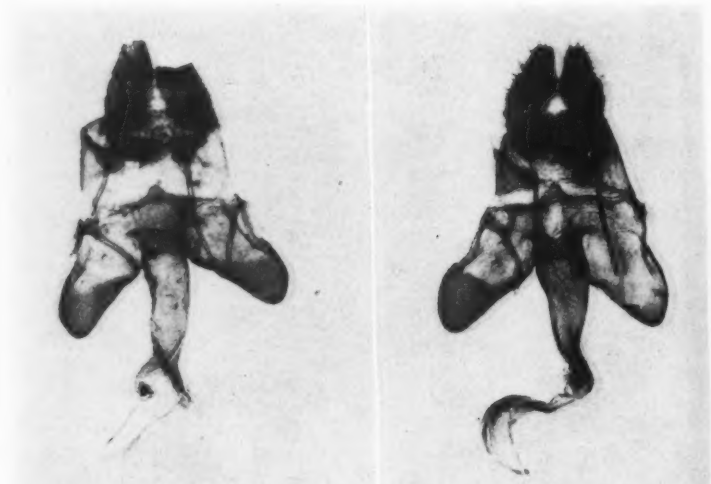


FIGURES 51–53.—Male genitalia of *Acleris maximana* (Barnes and Busck): 51, Wagon Camp, Mount Shasta, Calif., June 12, 1939 (G. H. and J. L. Sperry); slide 552-Obr; AMNH. 52, Rampart, Alaska; slide prepared by A. Busck, Jan. 8, 1924; USNM. 53, Fraser Mills, British Columbia, Sept. 11, 1921 (L. E. Marment); slide prepared by A. Busck, Oct. 10, 1923; USNM.



FIGURES 54–56.—Male genitalia of *Acleris maximana* (Barnes and Busck): 54, Wellington, British Columbia, April (G. W. Taylor); slide 544–Obr.; AMNH. 55, Wellington, British Columbia (G. W. Taylor); slide 539–Obr.; AMNH. 56, Pennsylvania; slide 534–Obr.; AMNH.





FIGURES 57–60.—Female genitalia of *Acleris maximana* (Barnes and Busck): 57, Slide prepared by A. Busck, Oct. 4, 1924 (see pl. 8, fig. 28). 58, Wellington, British Columbia, Mar. 24, 1903; slide prepared by A. Busck, Nov. 8, 1923; USNM. 59, Spring Creek, 4,000 ft., near Baker, Baker County, Oreg., June 10, 1953 (J. H. Baker); slide 424–Obr., AMNH. 60, Wellington, British Columbia, Mar. 28, 1903 (G. W. Taylor); slide 568–Obr.; AMNH.

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A REVISION OF THE NORTH AMERICAN ANNELID WORMS OF THE GENUS CAMBARINCOLA (OLIGOCHAETA: BRANCHIOBDELLIDAE)

By Richard L. Hoffman[1]

Introduction

The annelid worms of the oligochaete family Branchiobdellidae are for several reasons of more than casual interest to the zoologist. Owing to their singular mode of life as commensal or subparasitic inhabitants of freshwater crayfish throughout the Northern Hemisphere, they have departed in numerous respects from the more typical families of the order, and have developed such a leech-like habitus and appearance that for many years the Branchiobdellidae was thought to be a family in the Hirudinea. The problem remains unanswered: is the similarity of the two groups due to convergence influenced by environmental factors, or do the oligochaetes represent a way station along the evolutionary path taken by leeches? The life history has been worked out for none of the species, nor do we know more than a few inferential details about the distribution of any of them. Branchiobdellids should compel the interest of investigators

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if for no other reason than the position of the group on the borderline between commensalism and true parasitism, which ought to provide good clues about the evolution of the latter. It is obvious, however, that such studies can hardly be made until the classification of the group has been worked out, and specific identities firmly established. So far, no extensive work has been done in this direction.

The present study was rather in the nature of a test to see if the species of a widespread and somewhat heterogeneous branchiobdellid genus might be defined on the basis of such characters of the reproductive systems as have been found reliable in many other groups of invertebrate animals. Traditionally, genera as well as species in the Branchiobdellidae have been based on such characters as body form, shape of the jaws, even size of the animals. Clearly it would not take long to exhaust the possible combinations of such features, and by 1950 the taxonomy of American branchiobdellids had reached virtually an impasse. The major consideration underlying this investigation, therefore, has been the determination of what constitutes a species in the genus *Cambarincola*, and the development of coherent diagnoses by which these units may be subsequently identified. I feel that these objectives have been achieved with a fair measure of success.

An inquiry into characters of systematic value reveals that the most important appear to be the gross form as well as histological nature of the spermiducal gland and the adjoining prostate gland, and that these structures afford the basis for division of the genus into sections and groups. The two largest sections seem mainly to be composed of structurally generalized species on one hand and presumably more specialized forms on the other. That a satisfactory grouping of species into a system approximating the evolutionary or phylogenetic trends within the genus has been established is by no means asserted, however. That future studies will impose changes and modifications seems inevitable, yet a start must be made!

The species of *Cambarincola*, as now defined on the basis of the male reproductive organs, are remarkably constant for soft-bodied animals, and well-preserved material can be identified with virtually 100 percent confidence. Most of the species that are known from sufficient material are structurally uniform over their entire area of distribution, and the geographic ranges are in all cases entirely consistent with established biotic or physiographic provinces. The continent-wide distributions published by previous workers are largely the result of misidentifications.

In addition to the purely taxonomic aspect of this work, it has been possible to draw some inferences from present knowledge of structure

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and distributions concerning evolution in the group as well as the possible routes by which branchiobdellids settled the North American land-mass. I suspect that the worms came to this continent probably in late Cretaceous times on primitive astacine crayfish from eastern Asia, and that these crustaceans may have spread eastward across the continent—giving rise to the more specialized cambarine genera in eastern North America rather than in Mexico as postulated by students of the Decapoda. The present discontinuity in the distribution of *Cambarincola*, and the isolated, relict status of its most primitive forms, are thought to be the result of fragmentation of the old habitat conditions by climatic changes in the late Tertiary.

Acknowledgments

This study of *Cambarincola* was made at the suggestion, and under the sympathetic guidance of Dr. P. C. Holt. I take great pleasure in acknowledging the extent of his personal interest and concern in facilitating and furthering my investigations, always more in the role of longtime friend than that of major professor. The work was done while I was a candidate for the Ph. D. degree in the Graduate School of the Virginia Polytechnic Institute. Financial support was furnished by a research grant (G–4439) to Dr. Holt from the National Science Foundation.

I am likewise under an obligation to Dr. Fenner A. Chace, Curator of the Division of Marine Invertebrates, U.S. National Museum, who provided working space and the opportunity to study type specimens, and later kindly loaned the bulk of the Museum's holdings in branchiobdellids for study.

It is finally necessary to acknowledge the contribution of numerous collectors who have obtained the material with either a direct or indirect interest in branchiobdellids, particularly Mr. C. W. Hart, who made a special effort to obtain topotypes of *Astacobdella philadelphica*.

Review of the Literature

The first American species of *Cambarincola* to be described was placed in the genus *Astacobdella*, a group of Palearctic leeches (Leidy, 1851). Since that time, the generic concept has been slowly but progressively refined.

In 1894, J. P. Moore described several new species of branchiobdellids from eastern United States, and in his paper discussed Leidy's earlier name under the combination *Branchiobdella philadelphica*, and published an outline drawing of a specimen. The majority of Moore's work on this group involved species of other genera, although in a brief reference in his paper on the leeches of Illinois (1901) he

created the new combination *Bdellodrilus philadelphicus*. There is, of course, little close affinity between *philadelphica* and *Bdellodrilus illuminatus*.

Thus, by the beginning of the present century, only a single species of *Cambarincola* had been described among the total of six branchiobdellids then known from America. In 1912 a new impetus to the study of the group came in the form of two important papers. One of these was a synopsis of the entire family by Umberto Pierantoni, which listed all of the species known to him up to that time, and included the description of a new species, *Branchiobdella americana*, from Texas and North Carolina. This form is almost certainly a species of *Cambarincola* as the genus is defined today. Almost simultaneously, a short paper was published by Max M. Ellis in which *Cambarincola* was established as a new genus for the reception of the new species *macrodonta* from Colorado.

The description of *macrodonta* is a good one, and includes illustrations of the jaws and a partial diagram of the male reproductive system. Comparison was made largely with *philadelphica*, which was one of the originally included species, and which was differentiated largely on the basis of peristomial characters.

During the next several years, Ellis accumulated data from his own collections and that of the U.S. National Museum. In 1918 he published a brief annotated list of branchiobdellids obtained in northern Michigan, and provided a key for their identification. This treatment included *Cambarincola philadelphica* and a new species called *C. vitrea*, although the latter was not formally described and the notation was made that a complete description was then in press. In the following year appeared Ellis's major work, a summary of the branchiobdellid material of the U.S. National Museum. This paper included a discussion of variability in various systematic characters, photographs of entire animals, and the descriptions of several new genera and species. A key was given for the known forms of *Cambarincola*, with notes and records on established species and full descriptions of *C. vitrea*, *C. inversa*, and *C. chirocephala*, the last two names published for the first time.

Following the appearance of this useful paper, Ellis diverted his interests into other channels, and the systematic study of our branchiobdellid fauna languished for several decades. During the last years of the 1930's, Clarence J. Goodnight took up the study of the group, publishing several papers between 1939 and 1943. His major work is a synopsis of the North American branchiobdellids, which appeared in 1940. Here he accounted for 21 species in 9 genera, with 4 of the species being described as new. Insofar as *Cambarincola* was concerned, Goodnight admitted the genus in virtually the same sense as

did Ellis. It was placed in the new subfamily Cambarincolinae with 7 other genera and, in the key to these genera, placed next to *Xironogiton*, solely on the basis of having an "accessory sperm tube" (actually this structure is not present in *Xironogiton* at all). *Cambarincola* was then divided into two subgenera following the initial dichotomy in the key of Ellis (1919, p. 256), with species in which the "upper lip" is entire composing the nominate subgenus, and those with lobed peristomata forming a new subgenus *Coronata* which was set up for *philadelphica* and *chirocephala*. In the subgenus *Cambarincola*, the typical species *macrodonta* was associated with *inversa* and *vitrea* of Ellis, and a new species named *C. elevata*. Recent study has indicated that both *inversa* and *elevata* are members of quite different genera.

Subsequent to the appearance of his monograph, Dr. Goodnight published three additional short papers in which new species of *Cambarincola* were described: *C. floridana* in 1941, *C. meyeri* in 1942, and *C. macrocephala* in 1943. In his 1941 paper on the branchiobdellids of Florida, Goodnight listed four species for the State.

In 1947, the study of branchiobdellids was taken up by Perry C. Holt, and his Master's thesis, published in 1949, treated the comparative morphology of two species (*Xironogiton instabilius* and *Cambarincola philadelphica*) with respect to the male reproductive systems. From the detailed findings of this study, it became evident that the sexual organs, previously only casually mentioned in print, represent a source of the first magnitude for taxonomic characters. Holt's doctoral dissertation dealt primarily with other branchiobdellid genera, but included notes and studies on *Cambarincola*, and two of the new species recognized were subsequently published under the names *C. branchiophila* (1954) and *C. macbaini* (1955).

With the recent accumulation of extensive collections of specimens from many localities, it has become possible to undertake extensive systematic studies on American branchiobdellids, and as a preliminary step in an overall general program, the holotype and paratypes of *Cambarincola macrodonta* were restudied and the genus and species redefined in a short paper published by Holt and Hoffman (1959).

Two of the most important papers recently published by Holt treat the taxonomy and morphology of the genera *Ceratodrilus* (1960a) and *Ellisodrilus* (1960b).

Names and Type Specimens

In general, the overall validity and stability of any systematic revision increases proportionately to the number of type specimens examined. This is nowhere more true than in the case of the family Branchiobdellidae, inasmuch as very few of the published descriptions

are at all explicit concerning details which now must be known for the identification of species in the family.

I have discovered that *Cambarincola* has become something of a catch-all name which has been stretched to cover a wide diversity of species since its original proposal. So far, 13 species have been named in the genus, listed chronologically as follows:

C. philadelphica (Leidy, 1851)
C. macrodonta Ellis, 1912
C. vitrea Ellis, 1918
C. chirocephala Ellis, 1919
C. inversa Ellis, 1919
C. okadai Yamaguchi, 1933
C. elevata Goodnight, 1940
C. floridana Goodnight, 1941
C. meyeri Goodnight, 1942
C. macrocephela (sic) Goodnight, 1943
C. gracilis Robinson, 1954
C. branchiophila Holt, 1954
C. macbaini Holt, 1955

Of the above names, I have seen the type specimens of all but two: *philadelphica* and *okadai*. If Joseph Leidy prepared slides of his specimens, their present location is unknown. The specific concept of *philadelphica* here adopted was derived from topotype specimens, kindly obtained in Philadelphia by Mr. C. W. Hart, which agree in every particular with the original description. Information on *C. okadai* has been limited to what can be deduced from the description. Types of the remaining 11 species are in the collection of the Division of Marine Invertebrates, U.S. National Museum, and have been studied through the kindness of Dr. Fenner A. Chace.

On the basis of the generic concept developed during the course of this study, it has been determined that several of the foregoing species do not belong in *Cambarincola* as now defined. These are:

C. inversa Ellis: This species differs from *C. macrodonta* in details of the bursa and in lacking a prostate gland, as well as in the form of the jaws. Only the type slide has been available for study, but it is evident that *inversa* belongs to a different, as yet undefined genus.

C. elevata Goodnight: The internal structure cannot be seen in the poorly mounted holotype, but the recent examination of topotype material shows that this species likewise is not congeneric with *macrodonta*, and is being included instead in a new genus being readied for publication by Dr. Holt.

C. macbaini Holt: This species, and some others as yet unnamed, differs strikingly from the cambarincoloid forms in having a very long, filiform, protrusible penis, and forms the basis of another new genus soon to be proposed.

With these deletions, the number of valid forms in the genus to the present is reduced to 10. The examination of a great number of specimens in the Holt collection has disclosed a fair number of the described species (6 of the 10) and even more undescribed forms, of which 12 are named in the following pages. The type specimens of

these species are deposited in the U.S. National Museum, with paratypes retained by Dr. Holt.

In addition to the names in the preceding list, one other must be recognized as a probable member of the genus. This is the species described in 1912 as *Branchiobdella americana* Pierantoni. The description is not adequate for recognition of the species, and was probably composite in being based on specimens from Texas and from North Carolina. Until Pierantoni's material can be restudied and a lectotype designated, the status of this name remains in doubt, but the chances are good that it is based on specimens of *Cambarincola*.

Material Examined

The following summary of *Cambarincola* is based upon the examination of about 900 collections of branchiobdellids, some 800 of which contained species of this genus. Over 1100 individual slide mounts have been examined, each with an average of about eight worms per slide. Thus, approximately 9000 specimens of *Cambarincola* have actually been examined closely for structural details, and yet another thousand have been handled while sorting preserved material prior to making slides.

At least 90 percent of all this material is in the private collection of Dr. Perry C. Holt, now housed at the Virginia Polytechnic Institute. In addition, I have been able to examine the portion of the collection of Max M. Ellis which was turned over to the U.S. National Museum. These two sources constitute virtually all the specimens of branchiobdellids now available in North America.

Of the 22 species now accounted within the limits of the genus, I have been able to examine the types of all but two, as well as the type material of various other species described as *Cambarincola* but properly referable to other genera. All the existing holotypes are in the National Museum, paratypes of about half of the species are in the Holt collection.

Methods of Preparation and Study

Although the structure of the reproductive systems undoubtedly provides the best criteria by which species may be defined and their affinities established, it requires far more careful observation and study than has previously been expended in the mere determination of body form and jaw shape; the aspiring student of the Branchiobdellidae must be warned that the group is not one that can be comprehended with a few weeks of attention. The preparation of material for study is not difficult, but observation of the internal characters of even well-mounted specimens is almost always tedious. Probably a

year of continuous study is the minimum prerequisite for any sort of competence in the systematic study of the group.

Only well-preserved and accurately labeled material should be utilized. 80 or 90 percent alcohol (which may include 1 percent of a stock formalin solution) is suggested for initial preservation, and the collector should avoid overcrowding the jar with crayfish. Too many of the crustaceans in one container dilute the preservative and cause maceration of the worms. Isopropyl alcohol may be used, full strength, for preservation, although it is usually only about 70 percent in strength, and fewer crayfish can be placed in a given volume.

Material so preserved may be left indefinitely in jars with the host animals or isolated and restored in tiny shell vials plugged with cotton and packed in larger jars. Each collection may be assigned a different number which relates the specimen vial to collection data entered in a book or on index cards. Either the collection number alone, or a tiny label printed with a fine pen, will suffice to be included in the vial. Cataloging systems are limited only by the ingenuity of the individual, but in practice, the simpler a system the better.

In curating material, one removes the crayfish from the jars with enough vigorous shaking to dislodge any worms that may be still attached to the exoskeleton. It is also desirable to search the branchial chambers and gill filaments for gill-inhabiting forms, either by cutting open the carapace with stout scissors or by extracting the gills with a curved-tip forceps inserted between the carapace and bases of the legs. The gill material is then placed in a dish of alcohol and picked apart under a low-power dissecting microscope. This done, the majority of the alcohol is decanted carefully from the collecting jar to avoid loss of any of the bottom sediment which is then transferred to a flat glass dish and examined with a dissecting microscope.

In a given collection there may be but a single species or as many as four, each representing a different genus. As a rule these species will differ enough in habit form to facilitate easy separation, although in some cases identification even to genus is difficult until slides are prepared. In practice it is advisable to select good specimens of each form for mounting, all of which can be processed together. From the flat-bodied forms such as the species of *Xironogiton* and *Xironodrilus*, it is desirable to choose specimens which are least curled or twisted. From the cylindrical forms, which normally preserve in a sort of crescent-shaped profile, one should select those which are most nearly straight in the plane of the dorsoventral median body axis. Since knowledge of the jaw form is important, it is useful to prepare at least one specimen flattened dorsoventrally, or to remove the head from a specimen and split it along one side to allow for subsequent spreading at the time of mounting. This operation is easily done with a fine-

tipped scalpel or fragment of razor blade mounted in the end of a matchstick. In very large specimens (over 5.0 mm. long when preserved), it is often difficult to observe the reproductive system in whole mounts, and with a little practice it is easy to bisect the body between segments VI and VII, and then dissect out the male organs to be dehydrated and cleared separately.

Processing can easily be done in small glass dishes or similar containers. For ordinary whole mounts it is satisfactory to take specimens from the collecting jar into 95 percent alcohol, then through one change of absolute alcohol into clove oil. About 10 minutes in each stage is sufficient. All the material from each collection can be carried along in the same container, the fluids being added from dropping bottles and removed by a fine-tipped pipette.

Specimens may be mounted singly on each slide, or all of those which look alike mounted together, although this sometimes results in several species on a slide. I have used fairly thick balsam in a drop at the middle of the slide, subsequently spread out by the addition of a little clove oil around its base. Cleared specimens are removed from the clove oil with forceps or a bent needle and placed in the balsam, with specimens about equally divided according to which side is uppermost (to insure having at least one with the reproductive systems on the upper side). If dissected heads are involved, they can be spread in thicker balsam with the jaws uppermost and the coverslip applied quickly.

Slides in the Holt collection are prepared with the mount in the middle, leaving space for the catalog number and/or locality data label at the right end, and for an eventual determination label at the left. Following identification, an index card may be made out with the species name, number, and collection data, and filed in systematic order. Since a slide may contain several species, it is preferable that slides be stored in simple numerical order.

In the study of specimens, the use of medium high power magnification is mandatory, with a range of from about 60 to 600 diameters most desirable. Most of the present study has been made with a fluorite oil immersion objective, 40×,N.A. 100, corrected to a working distance of 1.5 mm., permitting the examination of relatively thick preparations inaccessible to the ordinary high dry and oil-immersion objectives.

Drawings are easily made with a camera lucida attachment, and measurements with a calibrated ocular micrometer.

In many instances, the student will find it impossible to determine single specimens with confidence. Contents of the gut may be so opaque as to conceal the sex organs, or the jaws may be in an unsatisfactory position. Specimens preserved in weak alcohol may be

macerated internally. Sometimes thick or opaque specimens can be utilized by turning the slide over and focusing on the other side of the animal, or by dissolving the balsam away in clove oil or xylol and remounting.

Very small animals, or those with complicated reproductive systems, must sometimes be imbedded in paraffin and sectioned. Well-known histological techniques, using a hematoxylin-eosin stain, suffice for serial sections. I have found no advantage in staining specimens for whole mounts.

Often it will be found necessary to derive specific characters from several specimens, there being few mounts in which all the desired details can be seen on a single animal.

Taxonomic Characters

The taxonomic utility of various anatomical systems in the Branchiobdellidae has been discussed in the literature at least four times. Insofar as earlier workers were concerned, general body form and shape of the jaws provided sufficient basis for the recognition of species, an opinion which unfortunately has survived in some quarters nearly down to the present time. That internal anatomy might furnish characters of really fundamental importance was first intimated by the still unsurpassed account of *Bdellodrilus illuminatus* by J. Percy Moore in 1895. Almost two decades later, Ellis (1912) relied to some extent on the form of the male reproductive systems in the diagnosis of his *Cambarincola macrodonta*, but in his subsequent work of 1919, Ellis largely reverted to nonsexual characters in the definition of genera and species. In this practice he was followed by C. J. Goodnight, and not until 1949 was the study of reproductive morphology revived by Perry C. Holt. Subsequent work by Holt, and that done under his direction by the present investigator, has been predicated upon the assumption that characters of the male reproductive systems provide the most reliable indices of evolution within the group, and, therefore, the best means for the definition of species and genera.

Ellis (1919) devoted considerable attention to the form of the jaws, the nomenclature of their dentition, and their mode of evolution, as well as to pharyngeal diverticula, intersegmental septa, and form of the gut. No further treatment of taxonomic characters appeared until 1935, when Yamaguchi provided a detailed consideration of various useful details, including the body form and ornamentation, jaw structure, and the internal characters mentioned by Ellis. Yamaguchi also discussed variations in the reproductive systems, but not in as much detail as might be desired.

Goodnight's monograph of 1940 reviewed the work of both Ellis and Yamaguchi, as well as several of their predecessors, and en-

deavored to evaluate the systematic value of the previously used characters. Goodnight, however, added little to our knowledge of this general subject, and his references to the structure of the sexual organs are meager. Finally, on the basis of his own knowledge of branchiobdellid anatomy, Holt (1953) published a review of previous work, and introduced information compelling greater attention to the reproductive systems.

The following discussion of anatomical characters which appear to be of taxonomic significance summarizes the points of interest which have been considered during the study of *Cambarincola* and related genera. It has been found necessary to review each character regarding its development in the family at large, and then particularly as it occurs within the more circumscribed limits of *Cambarincola*.

I. Body Form

Branchiobdellids vary greatly in form, but the typical appearance is that of an elongate fusiform cylinder, with a distinctly set-off head and a caudal sucker, both of variable dimensions but normally smaller than the head. In general each body segment is composed of two subsegments, of which the posterior is usually a little larger in diameter than the other. Several variations from this form occur: in *Xironogiton*, *Xironodrilus*, and some related genera not yet formally segregated from the latter, the body is strongly compressed dorsoventrally, broadest near the caudal end. In *Xironogiton* the body outline is unusual in being very abruptly narrowed anteriorly, having something of the shape of a tennis racket. In the poorly known genus *Triannulata*, each body segment is said to have three subsegments instead of two, although an approach to that condition occurs in the large species *Cambarincola macrocephala*. A terete body such as described in the first sentence characterizes most species of branchiobdellids, including all *Cambarincola*, and is probably the primitive condition in the family. Flattened bodies are doubtless specializations, although genera so formed are not always specialized in other particulars.

II. Body Size

Owing to the normally extensive degree of contractability characteristic of most oligochaetes, the subject of body size and proportions is not an easy one to treat satisfactorily. Branchiobdellids in life are able to double or halve their normal length during motion, and preserved and contracted specimens give an inadequate idea of the living animal. Yet with proper preservation, contraction is not excessive and species can be compared in general terms of relative size. Known species in the family range from about 1 mm. up to 18 mm. or more in length. Intraspecific variation tends to increase

with increase in size; smaller species usually remain within very close limits to their average. The range in size in *Cambarincola* is as great as for the rest of the family, with no particular affinities being reflected by the development of very large or very small forms, both of which occur in groups unrelated by other characters. Both size extremes appear to occur only in mountainous regions, whereas species of moderate dimensions tend to be widespread in lowland areas. In general, so far as *Cambarincola* is concerned, body size is often a good specific character, usually associated with other structural features, and is sometimes useful in identification.

III. Body Ornamentation

The vast majority of branchiobdellids are basically similar in external appearance, but in several forms the segments are provided with dorsal elaborations in the form of fleshy digitiform lobes of various length, or even large median processes which are distally branched. Species so ornamented have traditionally been thrown into the genus *Pterodrilus* without any consideration of other characters, and that "genus" has become a sort of assemblage of incongruous forms most of which are quite unrelated.

In many species the peristomium is produced into four lobes of variable size and length on the dorsal side. These structures reach their maximum development (among American species) in the genus *Ceratodrilus*, becoming nearly as long as the head. In *Cambarincola*, lobation of the peristomium occurs in various forms, and has been used and misused in the past for separation of species and subgenera, even though the significance of the character has been misunderstood. *Cambarincola philadelphica* has been considered by both Ellis and Goodnight to be very variable in this respect, but in actuality the variation ascribed to that species is due to a confusion of several distinct species under one name. Well defined peristomial lobes ("tentacles") occur in association with other characters and reflect specific distinctness of worms so endowed. They do not alone indicate relationships, however, for they occur in several groups of the genus *Cambarincola* as well as in *Ceratodrilus* and *Stephanodrilus*.

IV. Jaws

Branchiobdellids are the only Oligochaeta having sclerotized mouthparts (in the form of a dorsal and a ventral piece) of variable size and shape, but generally provided with caudally directed dentations or cusps on the posterior margins. (The name "jaw" is used only provisionally for the buccal armature of branchiobdellids, with the realization that it is certainly not homologous even with the mouthparts of polychaetes.) Ellis (1919) postulated that the

primitive condition involves subequal jaws in which the cusps are similar in size and shape, and that specialization influences enlargement of the median tooth of the upper jaw. He devised a system of nomenclature to reflect size order of the teeth, and is responsible for the term "dental formula" by which the number of teeth can be stated numerically (e.g., 5–4), indicating that the upper jaw has a median tooth and two more on each side while the lower jaw has two paramedian teeth plus one lateral cusp on each side. However, other arrangements are common, particularly in Oriental species. The American *Ceratodrilus* has small transverse jaws each with 6 to 8 equal dentations, and genera such as *Xironogiton* are likewise small-jawed but usually with a smaller number of teeth. Ellis studied variation in the jaws of what he considered to be *Cambarincola philadelphica* and found considerable individual variation, although it is now known that he had confused several species under that name.

Insofar as *Cambarincola* is concerned, there is considerable latitude in the ranges of variation, individual and geographic as well as specific. Individual variation is largely a function of age, with small specimens of a species having proportionately larger jaws in relation to head size, with more acute dentations. Older specimens tend to have the lateral cusps obscured or worn away. Geographic variation affects the relative length of the jaws in such species as *Cambarincola vitrea*.

The typical jaw arrangement in the genus is one of essentially equal-sized jaws, the dorsal with a large median tooth and two or four small lateral cusps, and the ventral jaw with two large paramedian terminal teeth and a pair of small lateral dentations. Various departures from this basic pattern occur, however, affecting both the relative size and dental formulae, and a rough classification can be drawn up as follows:

Jaws isomorphic, having the same outline in dorsal aspect, and the dental formula 5–5 or 3–3. In lateral aspect, the jaws are mirror images. The species so characterized can be called "homognathous," and they occur sporadically in different sections of the genus. *C. fallax* is a good example.

Jaws anisomorphic, being dissimilar in armature, the dental formula being 5–4 or some other combination of odd and even numbers. This general class is further divisible according to the relative size and shape of the teeth.

Teeth virtually subequal, presumably the primitive condition, occurring in *C. vitrea* and some related forms. Such species are "homodontous."

Teeth dissimilar, the median dorsal and paramedian ventral dentations enlarged, this being the most typical condition in the genus, and can once more be divided according to the relative size of the jaws:

Jaws similar in size in both lateral and dorsal aspects, this including the majority of species such as *C. philadelphica, macrodonta, ingens*, etc.

Jaws markedly dissimilar in size, the dorsal jaw up to four or five times as bulky as the ventral. This is presumably an advanced stage of specialization, and species so characterized may be called "heterognathous."

V. Male Reproductive System

The various species of Branchiobdellidae depart but slightly from a basic organization of the reproductive organs. The function of producing spermatozoa and collecting and conveying them to the exterior is accomplished by the same organs and structures in all members of the family, although the individual parts of the system are subject to variations which, when considered collectively, afford a fair opportunity for systematic diversification. The genital systems of species in the genera *Bdellodrilus* (Moore, 1895b), *Xironogiton* and *Cambarincola* (Holt, 1949), and *Ceratodrilus* and *Ellisodrilus* (Holt, 1960a, 1960b) have already been elucidated in print. The treatment of *Ceratodrilus* is of particular interest in providing a standardized and morphologically correct terminology to replace the various haphazard names which have been used or misused by previous workers. The following terminology is that developed by Holt (1960a). The sequence of the reproductive organs proceeds in order from the testes outward. Reference may profitably be made to the accompanying diagrammatic representation (figs. 1 and 2) of the arrangement.

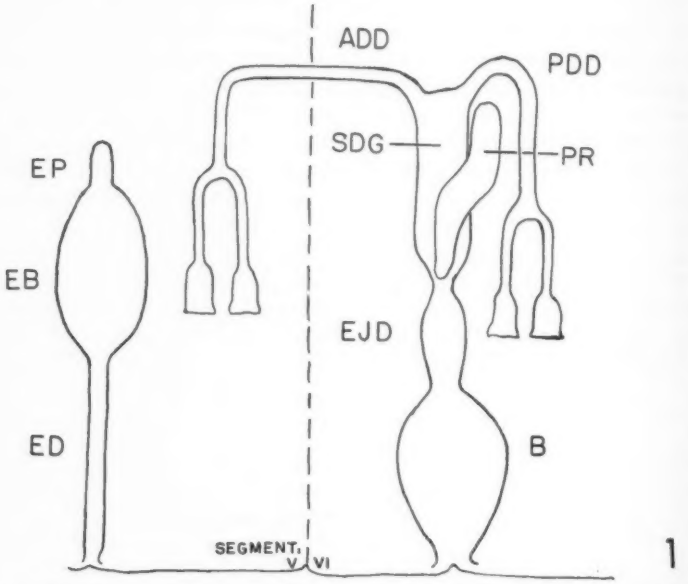


FIGURE 1.—Diagrammatic representation of the organs, other parts, and nomenclature of the reproductive systems in *Cambarincola*. (For explanation of abbreviations see figs. 2–5, p. 288.)

Testes. The spermatogenic tissue of branchiobdellids is concentrated into one or two pairs of testes located on the posterior face of segmental septa 4/5 and 5/6, or only on 5/6. As a rule the testes are perceptible as such only in immature animals, sexually mature adults show the condition in which the gonads have liberated morulae into the coelom, the fluid of which becomes filled with masses of spermatozoa and disintegrating blastophore material. As a rule, however, the sperm masses are easy to observe in most whole mounts, particularly as they tend to become oriented in clusters before the openings of the funnels, and provide evidence concerning the distribution of the testes. At least one genus (*Branchiobdella*) is provided with testes only in segment VI, a condition upon which Goodnight (1940b) has founded a subfamily Branchiobdellinae. That this difference is a fundamental one has been established by the recent examination of a European species of the genus, which has revealed additional peculiarities of the reproductive system as well. All the North American genera which have been studied in detail have two pairs of testes, and thus belong to Goodnight's subfamily Cambarincolinae. With *Branchiobdella* still very poorly known taxonomically, it is premature to postulate which of these two conditions is a primitive one.

Funnels. Spermatozoa are collected from the coelomic spaces of the testicular segments by the modified ends of the efferent ducts, which assume the general shape of a laboratory thistle-tube funnel—a subglobose enlargement, a subterminal constriction, and a slightly flared free margin. The entire structure is composed of a single layer of densely ciliated epithelial cells, and apparently varies in size and to some extent in shape among different species and genera. Normally the funnels are located in the lower posterior portion of the segments, their openings directed dorsolaterad and easily detected by the densely aggregated spermatozoa. Owing to the difficulty of obtaining precise measurements from whole mounts, and the general similarity of the funnels throughout the genus *Cambarincola*, their possible taxonomic utility has not been carefully investigated.

Efferent ducts. Each funnel is attached to a slender tubular efferent duct, which proceeds ventromesad into the vicinity of the bursa in segment VI. Here it unites with that of the opposed funnel, forming the deferent duct. The efferent ducts serving the funnels of segment V penetrate the septum of segments V/VI near its ventral margin, mesad to the funnels. Those confined to segment VI are to be found in the ventral portion immediately caudad to the bursa.

Deferent ducts. These conduits, formed by the union of a pair of the smaller efferent ducts, are histologically similar to them but average considerably larger in diameter. Originating in the general region of the atrial portion of the bursa, the deferent ducts proceed

more or less directly dorsad to merge with the ental end of the spermiducal gland, either more or less abruptly, or by way of an attenuated lobe of the latter organ. Holt (1954) has remarked considerable difference in the diameter of the deferent ducts between *C. branchiophila* and *C. philadelphica*, suggesting that in sectioned material it may be possible to note size differences of taxonomic significance.

Spermiducal gland. The union of the two deferent ducts brings us to an abruptly larger and more intricate portion of the sperm transfer system. This is a rather plump and heavily glandular organ of very variable size, shape, and proportions, composed internally of a single layer of glandular epithelium. It is located in all species on one side of segment VI, lying in the coelomic cavity between the gut and body wall and readily visible in well-cleared whole mounts. In all species of *Cambarincola*, the spermiducal gland is oriented in a distinctly oblique plane across the segment, with the ental end cephaloventrad in location, and the ectal end caudodorsal. In contracted specimens the orientation may be dorsoventral; eversion of the bursa tends to draw the ectal end ventrad, bending the gland into a C shape or alining it horizontally.

The precise function of the spermiducal gland remains in some doubt, although from its histological character we can assume it contributes some material beneficial to the passage of spermatozoa or to the accomplishment of sperm transfer. Anatomically, it is to be considered a specialized section of the deferent ducts both prior to, and ectad of their commissure into a single conduit. In some genera, such as *Branchiobdella*, the deferent ducts enter into the gland quite near its ectal end, with the main bulk of the organ greatly prolonged entally and variously coiled in the coelom. In *Cambarincola* and its related genera, the gland is basically Y or T shaped, the ental branches forming the places of entry of the deferent ducts, and this arrangement, from a morphological standpoint, is probably a reflection of the primitive form in early branchiobdellids. Departure from this arrangement seems to occur chiefly in the genera which are concomitantly specialized in other respects as well; in the spermiducal gland we have, therefore, a useful sort of yardstick for gaging affinities.

Assuming that a Y-shaped gland is a generalized condition, we can likewise essay an arrangement of the species of *Cambarincola* into groups or series of progressive specialization, culminating with the gland taking a simple tubular form with little or no lobing at the entry of the deferent ducts so that the Y shape is essentially lost. This morphological progression is one frequently employed in the following classification of the genus. When the entry of the ducts is marked by an acuminate production of the gland, so that the transition is a gradual one, the gland is regarded as "lobed" and the

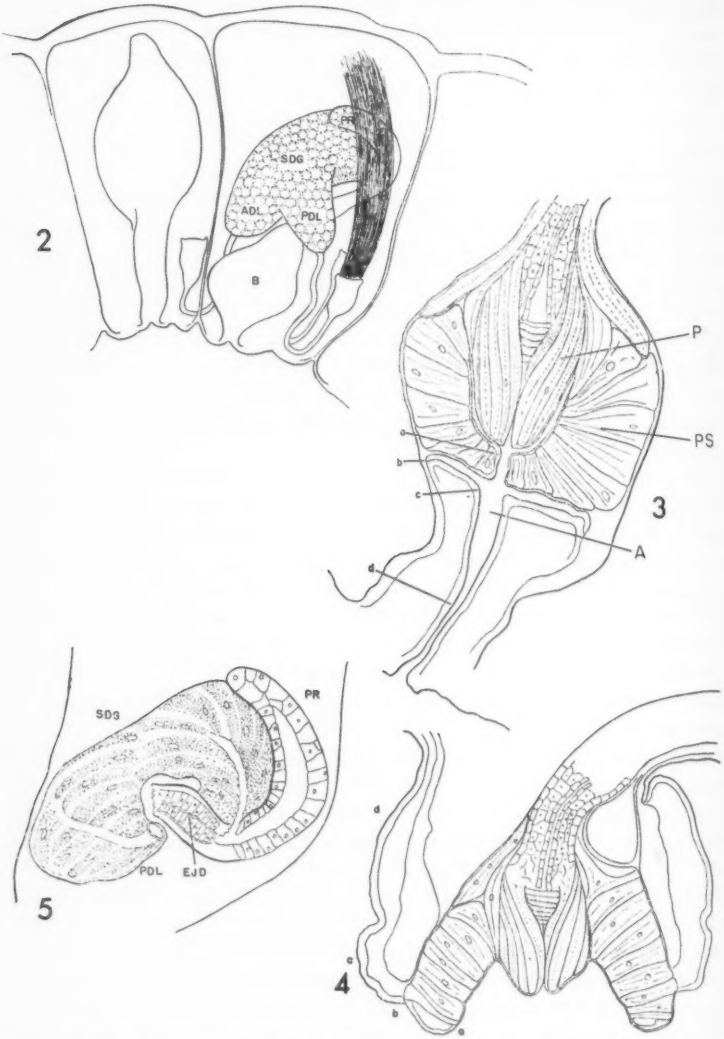
lobes are called anterior or posterior deferent lobes according to the position of the deferent ducts which enter them. The posterior ducts collect spermatozoa from the sixth segment, the anterior ducts from the fifth.

Prostate gland. This tubular structure is the "accessory sperm tube" of Ellis and other workers, but its function is almost certainly at least analogous to that of the prostate gland in other animal groups. Anatomically it originates at the junction (in most cases) of the spermiducal gland and the ejaculatory duct, and extends entally along the gland, both closely invested with a common (peritoneal) membrane. The histology of the prostate varies considerably. In some species it is superficially almost identical with the spermiducal gland in appearance, as regards both the size and apparent composition of the cells. In others there is a remarkable difference, one visible even under low power magnification, in that the prostate is made up of very large vacuolated cuboidal epithelial cells apparently with little or no secretory contents.

The actual size and shape of the prostate gland varies to a considerable extent, chiefly in diameter and length with respect to the spermiducal gland, and this variation is often of considerable diagnostic importance. It is of course necessary to make certain that the true dimensions are determined by a careful observation—the prostate is often partially concealed or its ental end turned away from the major axis, creating a much foreshortened effect. In at least one case, the diameter of the prostate in comparison with that of the spermiducal gland provides the major basis for separation of two species of the genus.

Entally the prostate ends blindly, although in the group in which it is histologically distinct from the spermiducal gland, there is a terminal development in the form of a clear bulb generally about the same diameter as the prostate proper, but occasionally somewhat rudimentary (in primitive species) or quite enlarged in specialized forms. The relationship of terminal bulb to vacuolated epithelial cells is so constant that the one is prima facie evidence of the other even when conditions prohibit direct observation of both!

Within the family Branchiobdellidae, the prostate gland apparently typifies the group of genera clustered around *Cambarincola* and may therefore serve a useful purpose as a tribal or subfamilial character. It is considered to be, in its simplest form, an outpocketing of the spermiducal gland which has, in the course of evolution, become histologically differentiated and altered in size and shape (from a broad short process to a long, slender, tubular one). I suspect that in at least one specialized branch of this part of the family, that which has produced *Ceratodrilus*, the tendency has been toward consolidation



FIGURES 2–5.—Cross-sections of male reproductive organs. 2, Reproductive systems of *Cambarincola shoshone*, showing typical orientation and location of the major organs within segments V and VI; 3, section through bursa of *C. ingens* in normal position; 4, cross-section through bursa of *C. ingens* in everted position; 5, cross-section through spermiducal gland, prostate, and part of ejaculatory duct in *C. philadelphica*. Histology semidiagrammatic, but size and shape of individual cells shown correctly. Abbreviations: A, atrium of bursa; ADD, anterior deferent duct; ADL, anterior deferent lobe

of the prostate back into the spermiducal gland, so that all remaining of it in existing species of that genus is the bulbar tip, occurring as a protuberance on the dorsal side of the gland near its ental end.

Ejaculatory duct. The spermiducal gland discharges to the outside through a tubular duct with distinctly muscular walls which is undoubtedly capable of spasmodic or peristaltic action, and which is appropriately named the ejaculatory duct (Holt, 1949). Both the structure and distribution of this duct vary greatly in the family. In certain genera (e.g., *Xironogiton*), it is quite thin-walled, probably the primitive condition. In at least one undescribed species referable to *Xironodrilus* in the sense of Ellis, it is absent altogether. In *Cambarincola macbaini* (for which a new genus is being proposed elsewhere), it is greatly enlarged and filled with a mass of convoluted tubing. From the morphological standpoint, the duct is simply a segment of the main sperm conducting passage; we should therefore expect the least modified condition to reflect the generalized or primitive state. Insofar as *Cambarincola* in the strict sense is concerned, the ejaculatory duct is basically similar through all the species—of about the same proportionate length and with a moderately muscular wall. Ectally it merges gradually into the penial sheath of the bursa.

Bursa. This, the outermost differentiated portion of the male reproductive system, is fundamentally a muscular invagination of the ventral body wall—invaginated to permit concealment of the penis well within the body, and muscular to achieve extrusion of the penis during copulation. The accompanying illustrations (figs. 3 and 4) afford some idea of the composition of the bursa, which is divided into two major anatomical parts: the penial sheath and the atrium.

In virtually all branchiobdellids the bursa is a subglobose to pyriform organ opening to the exterior at the midventral part of segment VI. Typically it projects mesad into the coelom or is directed somewhat caudad. Its ental half is taken up largely by the penial sheath (fig. 3, PS) which is the somewhat differentiated muscular area surrounding the ectal end of the ejaculatory duct and the virtually continuous penis. The latter is very variable in structure through the family, taking the form of a simple truncate cone which terminates the ejaculatory duct, or becoming gradually modified into a much

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of the spermiducal gland; B, bursa; EB, ental bulb; ED, ectal duct; EJD, ejaculatory duct; EP, ental process; P, penial part of bursa; PDD, posterior deferent duct; PDL, posterior deferent lobe of the spermiducal gland; PR, prostate gland; PS, penial sheath of bursa; SDG, spermiducal gland. The lower case letters a–d in figures 3 and 4 are located at the same anatomical position in both drawings.

longer structure capable of being itself everted independently of the bursa. The evolutionary trend in this particular is obvious enough.

In *Cambarincola*, the penis is invariably of the short cone type, and does not, in repose, extend ectad beyond the major band of circular muscle which approximately divides the bursa into halves. During copulation it is carried to the exterior by eversion of the bursa, which thrusts the penis and associated penial sheath down through the atrium and to the position it occupies as a median projection in a circular, distally concave structure formed by the lining of the atrium. This displacement of the atrium during eversion can be appreciated by comparison of the guide letters *a* through *d* in figures 3 and 4, showing that the inner wall of the atrium becomes the outer surface of the everted bursa. As the penis is, in this genus, capable of only limited penetration of the spermatheca of the copulatory partner, it is evident that the animals are obliged to achieve and maintain a very close ventral contact during the process of sperm transfer.

Eversion of the bursa is accomplished partly by contraction of the circular muscles of the ental half, and doubtless also in part by internal pressure achieved by contraction of the segmental muscles.

Summary of the male sex organs. Holt (1949) has shown that the entire male system, with the exception of the funnels and possibly the efferent ducts, is ensheathed by peritoneum, and all of the organs so invested are probably derived from the body wall. The interested student is referred to this paper for a more detailed treatment of the reproductive system. For the present, I consider them chiefly from the standpoint of their taxonomic utility.

It is postulated that the primitive arrangement for the family consists of two pairs of testes, funnels, and efferent ducts, one pair each in segments V and VI; two deferent ducts which merge into a Y-shaped glandular enlargement, the spermiducal gland—which probably lacks a prostate, and which does not extend entally beyond the entry of the deferent ducts; a thin-walled, muscular ejaculatory duct, and a simple, fusiform, eversible bursa which carries a short, conical, unmodified penis in its ental half.

Except for the presence of a prostate, the animal which comes closest to answering this description is a species of *Cambarincola*, to be described in a following section. Species which are almost antithetical to the foregoing are likewise known, but are members of North American genera as yet undescribed. However, a general progression away from most of the stipulated conditions can be found within the confines of the genus *Cambarincola*, suggesting its status as a dynamically evolving genus which has nonetheless retained, in

a relict status, species which approximate the postulated form of the ancestral stock.

VI. Female Reproductive System

The female sex organs are much less intricate than those of the male system, and are of considerably less significance in arriving at groupings of species. Perhaps of greatest utility is the general form of the spermatheca in providing supplementary points of difference between related forms.

Ovaries. The ovaries of branchiobdellids are located in the coelom of segment VII, and offer little for systematic use. The relative amount of their development, of course, provides a measure of the maturity of a specimen. In some species of the family, segment VII is rather distinctly the largest of the body units, and may enlarge anteriorly to somewhat overlap on the posterior part of segment VI. Insofar as *Cambarincola* is concerned, however, no appreciable differences are apparent either in the ovaries or the segment in which they occur.

Spermatheca. The spermatheca, throughout the family, so far as known, is a tubular structure formed by invagination of the mid-ventral body wall of segment V, and of variable size and shape. It is composed of several anatomically and histologically distinctive sections reflecting different aspects of the function of sperm reception, storage, and discharge. In some genera, of which most are still undescribed, the ectalmost part of the spermatheca is an enlarged, muscular structure reminiscent of the bursa, and possibly discharging a similar function. In *Pterodrilus* and *Cambarincola*, at least, the spermatheca begins ectally with a thin-walled, muscular duct which proceeds dorsolaterad around one side of the gut, terminating in a variously enlarged, fusiform to globose reservoir or ental bulb, the function of which is storage of spermatozoa. Histologically this part of the spermatheca differs appreciably from the duct in being only slightly muscular, and in gross appearance it is frequently semi-transparent or clear-walled. The diameter of this portion is subject to much variation, depending largely on whether or not it happens to contain sperm masses; however, the ratio of its length to that of the ectal duct seems to be relatively constant, and thus is available for diagnostic use. In various members of the genus, the ental bulb is terminated by an abruptly smaller lobe or process, the ental process. This is composed of deeply staining, small epithelial cells containing much granular material. These cells are doubtless secretory in function. As the ental process appears in general to be present and best developed in specialized members of the genus, it may be provisionally considered an evolutionary improvement in the spermathecal struc-

ture. Perhaps it provides some sort of secretion which facilitates longer retention of viable sperm. Generally speaking, in species which have been adjudged conservative or primitive on the basis of other characters, the spermatheca tends to have a long, slender ectal duct and a small, globose ental bulb without an ental process. More specialized species reduce the length of the ectal duct, enlarge the ental bulb, and add a glandular ental process.

Relationships Within the Family

So far, not enough is known of the branchiobdellids to permit the formulation of any lasting concepts about the affinities of genera to each other. A major difficulty lies in the fact that heretofore the classification has been based on characters which probably are of little phylogenetic significance, and preexisting genera have been heterogeneous as well as very poorly known. With the establishment of some comparatively severe generic definitions (only comparable, however, to those used in other phases of systematic zoology), it seems possible to summarize general impressions and ideas accumulated during this study of *Cambarincola*.

Although the Branchiobdellidae is a normally homogeneous family as regards general organization of body form and organ systems, histology, and way of life, a very considerable variation affects the structure of the reproductive systems. A basic dichotomy was made by Goodnight (1940) in recognizing two subfamilies according to the distribution of male germinal tissue. For species in which testes, or the morulae which they produce, occur only in segment VI, Goodnight proposed a subfamily Branchiobdellinae; for those in which spermatozoa are produced in segment V as well as VI, he provided the name Cambarincolinae. This difference, of course, had already been used by Pierantoni (1912) as a generic character, and does appear to be a fundamental distinction, particularly as it is reinforced, at least in the one species of *Branchiobdella* which I have examined, by correspondingly important differences in organization of the larger and more ectal parts of the male reproductive system.

Another basically important anatomical distinction between genera emphasized by several workers is the nature of the outlet of the anterior nephridia. In some genera the two ducts open to the outside independently of each other; in others there is a commonly shared nephridiopore. However, the nature of this relationship is often (in fact usually) difficult to detect with complete confidence, and we are denied the use of literature reports based on the study of whole mounts. In cases where the nephridiopore has been carefully studied by the use of serial sections, it does afford strong presumptive evidence of relationships.

The basic similarities in structure, shape, arrangement, and histology of the reproductive systems, however, certainly represent the best reflection of affinities. That this statement is true within the confines of genera is strongly supported by the findings outlined in the systematic treatment which follows. The thin, and usually subjectively drawn, line between species groups and genera permits, I think, an extension of the principle into so-called higher categories.

From the preceding discussions of characters, it will be recalled that within the limits of *Cambarincola* one finds a fair amount of variation within the reproductive system both in the gross and histological appearance of the individual organs. The casual observer might suspect, perhaps with justification, that by placing major emphasis upon different organs one could arrive at several entirely different classifications. This is not only theoretically true, it is a difficulty which has been a source of vexation since this investigation was begun. The solution has been an arbitrary one, influenced in no small measure by the more or less unconscious accumulation of small impressions which collectively result in a conscious allocation of species by the totality of their characters. After several abortive classifications had been drawn up and found wanting, I struck upon the one which immediately appeared satisfactory and this, which has met the test of having to accommodate additional and unforeseen species, is the one here used. The organization of the bursa is given pre-eminence, within limits, in the definition of the genus.

In the preceding section I have discussed something of the variability of this structure among various branchiobdellids, and pointed out that a surprising amount of diversification is to be found in such a basically simple arrangement. There is now known to be a number of species which share the fundamental "cambarincoloid" organization of bursa, ejaculatory duct, spermiducal gland, prostate gland, two deferent ducts, and four efferent ducts and funnels, in addition to a terete body form and a generally similar appearance. However, a detailed study of the bursa shows that on the basis of its several modifications, these species can be classified into groups, in which the component species are obviously quite similar and related in small details as well as overall facies. That bursa structure is a character of major importance is attested by the homogeneity of these groups, which are certainly entitled to be called genera by any definition but the most inclusive. It is now altogether likely that "Cambarincola" in the usage of Ellis will be found to correspond roughly to the bounds of a subfamily[!] in terms of modern classification.

We have, then, to consider basically a number of species of North American branchiobdellids in which the body is cylindrical, the nephridiopore single, the spermatheca not divided or branched,

segments v and vi testicular, and the male sex organs consist of the elements listed in the preceding paragraph. Discounting poorly described species, there are about 18 forms, which Goodnight placed in the 3 genera *Pterodrilus*, *Cirrodrilus*, and *Cambarincola*. Of these three, *Cirrodrilus* has been disposed of (Holt, 1960a) in a careful paper which restores the correct name *Ceratodrilus* to the American species and elucidates the anatomy of the genus. This genus differs from all others in the collective characters of (1) eversible penis, (2) virtual absence of the prostate gland, (3) great elaboration of segmental and peristomial epidermal tentacles.

Cambarincola in the usage of Ellis and Goodnight is of course heterogeneous. The genus in the strict sense includes only those species which do not have segmental ornamentation, in which the bursa, but not the small penis, is eversible (or extrusible), the ejaculatory duct is not strongly modified, and the prostate gland is present and functional. This combination of characters rules out three known species originally described in the genus: *inversa* Ellis, *elevata* Goodnight, and *macbaini* Holt. Each of the last two named represents a distinct generic type, now being defined and readied for publication by Professor Holt. We have studied the types of *C. inversa* and regard it, too, as worthy of generic rank, but action is deferred pending the acquisition of fresh material for sectioning.

Pterodrilus is likewise heterogeneous. The species *alcicornus* and *distichus* (with two additional undescribed forms) are basically very similar internally. *P. mexicanus* is still unknown save from the poorly preserved type specimen. But *P. durbini* of Ellis is remarkably different, and belongs to the recently described genus *Ellisodrilus* (Holt, 1960b), along with a second, previously unknown related species, *E. clitellatus*.

With all of these eliminations and realinements which have resulted from a close comparative study of important internal organs, we are left with a genus *Cambarincola* in a strict sense (which nonetheless is now known to contain no less than 21 species), and a genus *Pterodrilus* with two known and two more undescribed forms; and insofar as internal structure is concerned, these two genera might be considered identical.

Here the element of arbitrary decision has its hour upon the stage. Some authors who may work with branchiobdellids at a future time will perhaps desire to combine the two genera under the older name *Pterodrilus*. My personal feeling is that although the two groups are beyond peradventure very closely related, the evidence suggests that the species of *Pterodrilus* represent an extreme specialization of some early embranchment of the Philadelphica section of *Cambarincola*. Evolutionary recency is suggested by the small size of the

species, greatly reduced jaws, moderate to elaborate development of segmental ornamentation, and extreme enlargement of the prostate both with respect to its size in comparison with the spermiducal gland, and as regards the great size of the individual cuboidal cells.

Critics of a narrowly defined genus might object that *Pterodrilus* differs less from the Philadelphica section of *Cambarincola* than the latter does from the Mesochorea section. But this is a matter of personal preference, and something which must be settled by the test of future usage. The recognition as a genus of a specialized offshoot of some diverse genus has ample historical precedent. The lizard genus *Uta* is generally recognized as only a modification of one of the groups of *Sceloporus*, and doubtless a long list of similar evidence could be marshalled in support of the *Pterodrilus-Cambarincola* relationship.

Unfortunately, as regards other genera, relationships are not so clear. The tendency toward development of an eversible (and ultimately an extrusible) penis seems clearly a specialization, but one which had perhaps been achieved independently and at different times. Within the group of genera which are so endowed, there exists considerable variation as regards presence or absence of the prostate, modification of the ejaculatory duct, and modification of the spermatheca. Since these genera are composed largely of very small worms, with every indication that a great many remain to be found and studied, it would be premature to venture any opinion on their affinities.

Whether the genera *Triannulata* and *Stephanodrilus* (the latter in the sense of Goodnight's usage of it for a Californian species) differ from *Cambarincola* is something which remains for future settlement.

Phylogenetic Considerations

The following remarks constitute an attempt to summarize the inferences which can be reasonably drawn from our present state of knowledge of the genus *Cambarincola*. It seems relatively safe to assume that probably most of the more common species of the genus have been described, although a number of localized forms undoubtedly remain to be discovered.

Some criteria have been set up for the evaluation of certain diagnostic characters against the standard of a hypothetical ancestral condition (cf. pp. 281–291). On the basis of these criteria, it is possible to consider some species as primitive and some as specialized in the two largest sections of the genus. By restricting comparisons to the members of a given section, rather than the genus as a whole, we find that the presumptive conservative forms tend to be scarce,

localized, and on or near the periphery of the range of the group or section.

Most of the United States, east of the 105th Meridian, is occupied by at least two species of *Cambarincola*, although as a rule the area shared by any two given species is not extensive (*mesochorea* and *vitrea* have the greatest territory in common). The number of species tends to increase in certain regions—to five in the Ozark area and to seven in southwest Virginia (the Pacific Northwest, still largely unknown, must be omitted from consideration but it probably also has a large number of species).

Now the interesting inference to be drawn from known distributions in the genus is that—in comparison with other members of their respective subgeneric section—none of the species of the Appalachian fauna can be considered as primitive, such forms rather occurring in lowland regions where two or three widespread forms of *Cambarincola* are the dominant and often the only branchiobdellids. In short, morphologically primitive species do not occur in the regions having the richest branchiobdellid fauna at the present time.

It will be recalled from a previous section (p. 290), that the generalized species of *Cambarincola* represent to a considerable extent the hypothetical form and structure of the familial archetype, and that members of the Mesochorea section of the genus lack specializations in virtually all of the major diagnostic characters. It is therefore particularly significant that these species are, in a sense, now known largely as relicts strung out along a highly probable route of migration taken by cambarine crayfish in their occupation of eastern North America. The two most primitive known species of the genus are endemic to the Ozark region. A single species (*holti*) of the Macrocephala group occurs in central Kentucky; its nearest relative in the Columbia River system. The two species of the Branchiophila group have essentially the same sort of transcontinental distribution.

The distinctly more specialized Philadelphica group has its center of abundance in the southern Appalachians where six species occur, along with a variety of species of *Pterodrilus* and *Xironodrilus*. One species of the Philadelphica group, *macrodonta*, occurs in the foothills of the Rockies and in the adjacent High Plains, but it may be continuously linked up with the Appalachian fauna by way of Wisconsin and Michigan (see map, fig. 57). Another species, *chirocephala*, extends westward into the Ozarks and adjacent Great Plains. Two other closely related species, *osceola* and *vitrea*, occur in the Great Plains and southeastern Coastal Plain; they are both somewhat primitive within the Philadelphica section. The true Appalachian endemics (*C. ingens*, *C. heterognatha*, *C. holostoma*, and *C. fallax*, all of the Philadelphica group, and the one known species of the Demissa

section) are all specialized both in their respective sections as well as in the entire genus.

It is, unfortunately, not possible to date the course of events in a postulated phylogenetic scheme in any but the roughest terms. We can assume from paleobotanical evidence a widespread occurrence of the so-called Arcto-Tertiary forest across midland North America as late as the Miocene, and the gradual conversion of this area into semiarid grassland in the Pliocene. This change of basic habitat must have commenced a schism of earlier broad ranges which was culminated by Pleistocene glaciation.

The apparent lack of endemism in glaciated parts of the continent suggest both a low rate of evolution and relative recency of post-glacial northward migration by crayfish. The presence of *C. philadelphica* in Wisconsin is in all probability due to its isolation there in the well-known driftless area. At present I know of no authentic records for the species between Wisconsin and New York.

A very provisional reconstruction of the events by which *Cambarincola* has undergone dispersal and evolution in North America might be about as follows:

1. The procambarincolid stock arrived on this continent from northeastern Asia, as commensals on primitive astacine crayfish perhaps during late Cretaceous or early Tertiary times. During this period western North America was subjected to considerable uplift and downwarping; large extensions of the sea covered much of the southwest and it seems doubtful that crayfish were able to occupy much territory until the Eocene brought widespread emergence and generally uniform subtropical climate to the continent. The spread of the cambarine crayfish (which presumably evolved in America by the loss of branchial elements and specialization of certain pleopods) into eastern North America could scarcely have taken place prior to withdrawal of the midcontinental Cretaceous embayments.

2. The species of the Mesochorea section of the genus developed in something like their present form, with numerous species or widely ranging ones (perhaps both) similar to the Recent *C. ouachita*, occurring nearly across the continent.

3. Perhaps along with the crayfish genera *Orconectes* and *Cambarus*, cambarincolids occupied the Appalachian system, which was then being developed by dissection of the old Cretaceous peneplain and doubtless afforded a new type of habitat. Here both crustaceans and annelids prospered, and the Philadelphica section had its origin by gradual differentiation of the prostate gland and diminution of the deferent lobes of the spermiducal gland. New and more specialized forms continued to evolve here, doubtlessly enhanced by the opportunities for localized geographic speciation in mountainous terrain,

causing older forms of the section to become extinct or isolated in less competitive situations (such as the semilowland habitat occupied by *C. virginica*).

4. The preceding events probably occurred prior to and during the Miocene. We can postulate that two major groups of species existed: a primitive group of species in the midcontinental region and a specialized, more rapidly evolving one in the still rugged Appalachians. In late Miocene, however, the moderation of earlier climate brought a change to North America, replacing the subtropical plant life with a more boreal Arcto-Tertiary flora and inaugurating more pronounced seasonal cycles. This now widespread environment may have favored the expansion of specialized cool-water forms westward into the range of older species and must have caused a decline in the abundance of the latter. Possibly the *philadelphica* stock spread as far west as Colorado at this time.

5. During the Pliocene abrupt climatic changes occurred, owing to considerable orogeny in the Pacific Coast region and elsewhere, converting the Interior of the continent into a subarid grassland and creating extensive desert areas in the intermontane basins. The distribution of *Cambarincola* was at this time severely fractured, with the Mesochorea section remaining as a rather relict group on both sides of the Continental Divide. The Philadelphica section, which had spread westward only as far as the present site of the Rockies, was thus contained in eastern North America.

6. The effects of Pleistocene glaciation on *Cambarincola* have probably been only to pre-empt species from higher latitudes in eastern North America. Only fairly widespread and successful species have invaded glaciated terrain. No new species of this genus seem to have evolved during this process. *Pterodrilus distichus* Moore is known to be virtually restricted to glaciated areas, and three or four species in more highly specialized genera, as yet undescribed, are either endemic to glaciated areas or are most abundant there. Whether this reflects accelerated evolutionary rates or greater adaptability in the occupation of new terrain than in *Cambarincola* I cannot guess.

It is finally interesting to observe that utilization of crayfish as habitat by branchiobdellids must antedate the evolution of the American cambarine crayfish, since several congeneric species in at least three branchiobdellid genera inhabit both *Pacifastacus* of the Astacinae and various genera of the Cambarinae. Without direct geological evidence, we can safely grant the genus *Cambarincola* a considerable antiquity.

Systematic Treatment

Genus *Cambarincola* Ellis

Cambarincola Ellis, 1912, Proc. U.S. Nat. Mus., vol. 42, p. 481; 1919, vol. 48, p. 190.—Goodnight, 1940, Illinois Biol. Monogr., vol. 17, No. 3, p. 30.—Holt and Hoffman, 1959, Journ. Tennessee Acad. Sci., vol. 34, p. 102.

TYPE SPECIES.—*Cambarincola macrodonta* Ellis, 1912, by original designation.

DIAGNOSIS.—Branchiobdellidae with the following characteristics: Body terete, without specialized projections; jaws normally large and massive, subtriangular in dorsal aspect, the dorsal jaws with a large median tooth and usually two smaller cusps on each side (these subequal to median tooth in one form), the ventral jaws with normally a median sinus and two large paramedian dentations, or occasionally of the same form as the dorsal. Anterior nephridia opening through a common median dorsal papilla on segment III.

Male reproductive system. Bursa subpyriform to obcordate, becoming broadest entally, capable of being everted; ental portion of bursa modified into a penial sheath enclosing a distinct, subconical penis which is noneversible but is carried to the outside by eversion of the entire bursa. An ejaculatory duct is present, normally at least half as long as the bursa and with strong muscular walls but not otherwise enlarged or specialized; spermiducal gland relatively large, basically cylindrical but occasionally compressed and/or produced into a large subterminal lobe at the entry of one of the deferent ducts, histologically the gland is composed of tall, columnar, basophilic glandular cells surrounding a rather narrow lumen. A prostate gland is present, its origin adjacent to the commissure of the ejaculatory duct and spermiducal gland; length and diameter variable but normally of much smaller dimension than the spermiducal gland against which it is closely applied (the two structures are enclosed by a common membranous sheath). Histologically the prostate may be similar to the spermiducal gland or may be composed of large, vacuolated cuboidal epithelial cells which contrast strongly with the smaller glandular cells of the gland itself, in this condition the prostate always terminates entally in a thin-walled bulbous structure.

Female reproductive system. Spermatheca with a more or less elongate ectal portion, generally distinctly muscular, and a thin-walled ental portion normally expanded or enlarged and capable of much distention, often with a smaller ental process. Spermatheca never branched or diverticulate.

DISTRIBUTION.—So far as is known, *Cambarincola* is endemic to North America. The majority of the known species occur in eastern United States, although several have been found in the Columbia

River system, and it is to be expected that further explorations will greatly augment the list of forms inhabiting northwestern North America.

Endemism apparently is characteristic of several species on a very localized basis. Most of the species are known from a number of localities even though the totality of the specific range may be very modest; but several forms are still known only from their type localities. In a general way, it appears that species of moderate size enjoy the widest distributions, with both very large and very small species being more or less limited to relatively small confines—usually in mountainous regions.

Goodnight (1939), on the basis of the 21 species of the family which he knew from North America, established four major faunal assemblages (he called them "faunal regions") characterized by various groups of species and genera. Now although the recognition of faunal assemblages associated with different physiographic regions is a natural and very desirable outgrowth of systematic studies, it must be obvious to the most naive that such arrangements are no better than the current state of taxonomic knowledge. Goodnight's proposal was made 20 years too soon, at the very least, since he knew but a fraction of the actual number of American species of Branchiobdellidae.

SUBGENERIC GROUPINGS.—Generally any large ensemble of species of a given genus will be divisible into groups of related forms, although the actual degree of affinity may be quite variable. Since an understanding of phylogeny and evolution depends largely upon the arrangement of species into progressively smaller ranks with progressively greater interspecific similarity, I have endeavored to allocate the species of *Cambarincola* which I have personally studied into a subgeneric classification. This system is above all a subjective one, both in the selection of diagnostic characters and the relative importance assigned to each. That it will be immune to future modifications, or even abolition, now seems improbable. I suggest a basic division into three sections, two of which are large and diverse enough for further refinement into groups. In one case, subgroups are introduced.

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C. vitrea Ellis	25, 28, 29, 31
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Ingens group	
C. ingens, new species	3, 4, 33, 34
Philadelphica group	
C. philadelphica (Leidy)	39–42, 51–54, 57
C. chirocephala Ellis	43–50, 57
C. macrodonta Ellis	37, 38, 55, 56, 57
C. meyeri Goodnight	67, 68
C. fallax, new species	58–60, 62, 63
C. holostoma, new species	61, 64–66
Heterognatha group	
C. heterognatha, new species	69–71, 74
Demissa section	
Demissa group	
C. demissa, new species	72, 73
Uncertain position	
C. floridana Goodnight	75, 76
C. gracilis Robinson	77–79

It must be emphasized that although clear-cut distinctions are made in keys and diagnoses, there appear to be no major breaks anywhere in the genus, either in a single structure or group of characters in combination, that might conceivably threaten the homogeneity of *Cambarincola* as a generic entity.

Key to Sections of the Genus *Cambarincola*

1. Prostate and spermiducal glands of the male reproductive system histologically similar, both containing visible secretory granules 2
   Prostate and spermiducal glands dissimilar in histological appearance, cells of the former lacking visible secretory granules.
   PHILADELPHICA SECTION (p. 320)
2. Prostate gland terminating in a small clear bulb; all of the reproductive organs drastically reduced in size . . . . . DEMISSA SECTION (p. 365)
   Prostate gland not terminating in a clear bulbar structure; reproductive organs all of normal size for the genus . . . MESOCHOREA SECTION (p. 301)

MESOCHOREA SECTION

Six species of the genus are here referred to the section typified by *Cambarincola mesochorea*, in which the prostate gland is histologically similar to the spermiducal gland, and the latter is normally provided with large and distinct deferent lobes. These species are further

segregated into three groups based upon more numerous similarities in details of both body form and reproductive organs.

Presumably this section includes the more primitive species, or at least those in which presumed primitive characters are preserved. With one exception, each species is remarkably localized, four being known only from the type localities, the fifth from only two places. I should expect that such distributional patterns would be indicative of reliction, following disintegration of a formerly more inclusive range of the parental stock. The localized species now occupy peripheral localities on the known distribution of the section; *C. mesochorea* alone is widely distributed in the central area. That it is possibly the most specialized of the six correlates well with its present abundance and extensive geographic range.

Key to Groups of the Mesochorea Section

1. Prostate gland appreciably broader and longer, in most specimens, than the spermiducal gland; latter essentially without distinct lateral deferent lobe. MESOCHOREA GROUP (p. 302)

   Prostate gland equal in size to, or much smaller than, the spermiducal gland; latter with either subequal terminally located deferent lobes (thus T- or Y-shaped) or with a distinct lateral lobe 2

2. Spermiducal gland long and cylindrical, terminating in virtually similar deferent lobes; prostate fully as long as spermiducal gland. Very large species, with tentaculate peristomium . . MACROCEPHALA GROUP (p. 311)

   Spermiducal gland shorter, cuneate or acuminate, terminating in a major deferent lobe subtended by a smaller lateral lobe (sometimes these may appear terminal and subequal); prostate gland only half as long as spermiducal gland or less. Small species, the peristomium not tentaculate. BRANCHIOPHILA GROUP (p. 316)

MESOCHOREA GROUP

Proposed for the inclusion of three rather generalized or primitive species, this group is to be ranked at the bottom of the evolutionary scale in the genus, although its components show considerable differentiation among themselves. Similar in general form of the male sex organs to the species of the Macrocephala group, the present species lack any of the specializations which mark the others. The prostate is greatly enlarged and the posterior deferent lobe is virtually obliterated in two species although still conspicuous in the other.

Cambarincola mesochorea is fairly widespread over the interior of the continent; *C. ouachita* is known only from the type locality in southeastern Kansas. This is a most unusual relationship and one warranting further study. The two species are very similar in their medium size, general body outline, jaw structure, and reproductive systems. *C. restans* is remarkably different from anything else in the genus because of its head size and body shape. The sex organs are much

like those of *mesochorea*. I would arrange these species in the following order of advancement: *ouachita*, *restans*, and *mesochorea*, although this is a merely relative sequence and does not imply a straight line of descent. Despite its several distinctive characters, *mesochorea* has been confused with both *C. macrodonta* and *C. vitrea* in earlier literature; it is probably the basis for many of Goodnight's records for both *macrodonta* and *philadelphica*.

Key to Species of the Mesochorea Group

1. Spermiducal gland with a large, conspicuous, posterior deferent lobe at its midlength; body form somewhat xironodriloid (southeastern Kansas).
Cambarincola ouachita, new species
Spermiducal gland without a large median posterior deferent lobe, the deferent ducts entering the extreme ental end of the gland with no enlargement; body form distinctly cambarincoloid 2
2. Body form normal for the genus, head smaller than the second body segment, body diameter increasing up to segment VI or VII (entire Mississippi River system) . . . . . **Cambarincola mesochorea,** new species
Body form unusual: head half again as thick as largest body segment and as long as first five segments combined; all body segments of essentially the same diameter (northeastern Arkansas).
Cambarincola restans, new species

Cambarincola ouachita, new species

FIGURES 8, 9

TYPE SPECIMENS.—Holotype and one paratype, USNM 29937, from *Orconectes* sp., collected 4.3 miles west of the Montgomery County line on Kansas Hy. 168, Chautauqua County, Kansas by P.C. Holt, July 8, 1958.

DIAGNOSIS.—A rather large member of the Mesochorea group, differing from the other two by its larger, somewhat xironodriloid body form, and also by the presence of a large and conspicuous posterior deferent lobe on the spermiducal gland.

DESCRIPTION.—A medium-sized member of the genus, with a maximum length about 4.0 mm., the body rather elongated and parallel-sided (in both specimens), somewhat reminiscent of the shape of certain species of *Xironodrilus*. Segments II-VIII of about the same diameter and length; caudal sucker about as wide as head or segment I. Segments only a little longer than broad; prosomites not elevated over level of metasomites and less than twice the length of the latter.

Head of average size and form for the genus, as broad as segment I, not quite as long as first three body segments, the peristomium set off by a deep constriction and flared, but with entire margin.

Jaws robust, anisomorphic, dental formula 5–4, teeth subhomodont, acute.

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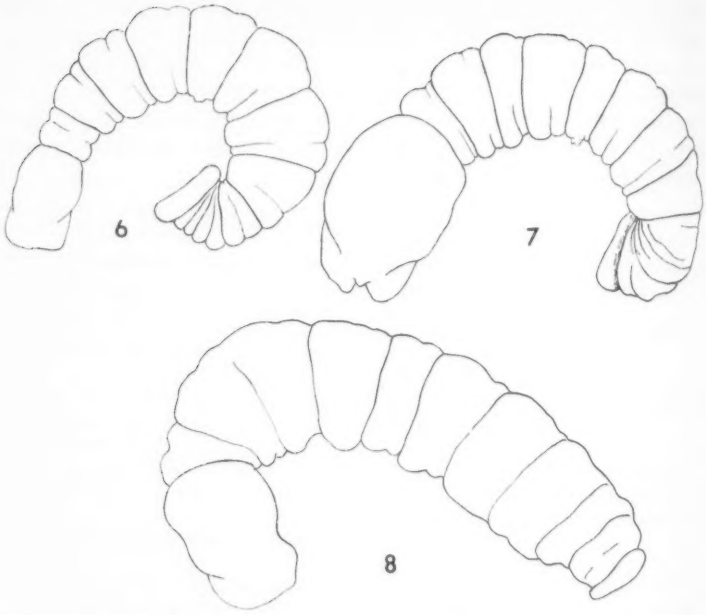


FIGURES 6–8.—Habit sketches of three species of the Mesochorea section, lateral aspect. 6, *Cambarincola mesochorea*, new species, paratype, Perry Co., Indiana (a little smaller than the normal adult size). 7, *C. restans*, new species, paratype from Benton Co., Arkansas. 8, *C. ouachita*, new species, holotype, Chautauqua Co., Kansas (specimen distorted in preservation). All figures drawn to same scale.

Male reproductive system occupying most of one side of the coelom of segment VI. Bursa elongate-fusiform, much longer than broad. Ejaculatory duct in type specimen recurved first ventrad then abruptly dorsad, drawing down the caudal end of the spermiducal gland. Latter elongate, cylindrical, curving cephalad across top of bursa, then ventrad to level of the middle of latter, thence mesad and tapering into the anterior deferent duct. Posterior deferent lobe very large and conspicuous, located at about midlength of spermiducal gland, directed caudad over base of ejaculatory duct and apex of penial sheath, thence caudomesad to merge with the posterior deferent duct. Prostate as large in diameter as spermiducal gland, curving along its dorsal side as far as the beginning of the anterior deferent lobe.

Spermatheca not completely visible in either type specimen, but appearing to be composed of a slender ectal duct and a subglobose ental bulb, no ental process observed.

AFFINITIES.—In general body form, jaw structure, and great size of the prostate, this species is obviously allied to *mesochorea*, with which it is apparently sympatric. The major difference between the two lies in the large and distinct posterior deferent lobe of *ouachita*, and by the fact that the anterior lobe is somewhat longer than the prostate. Whether we are dealing here with two distinct species, or the local recrudescence of a primitive character within a population of *mesochorea* is something to be settled by future study of the Kansas-Oklahoma branchiobdellid fauna.

Cambarincola restans, new species

FIGURES 7, 10

TYPE SPECIMENS.—Holotype and two paratypes, USNM 29938, from *Orconectes* sp. taken in Sugar Creek, 2 miles north of Avoca, Benton County, Arkansas by P. C. Holt, July 6, 1958. Topoparatypes, PCH 768.

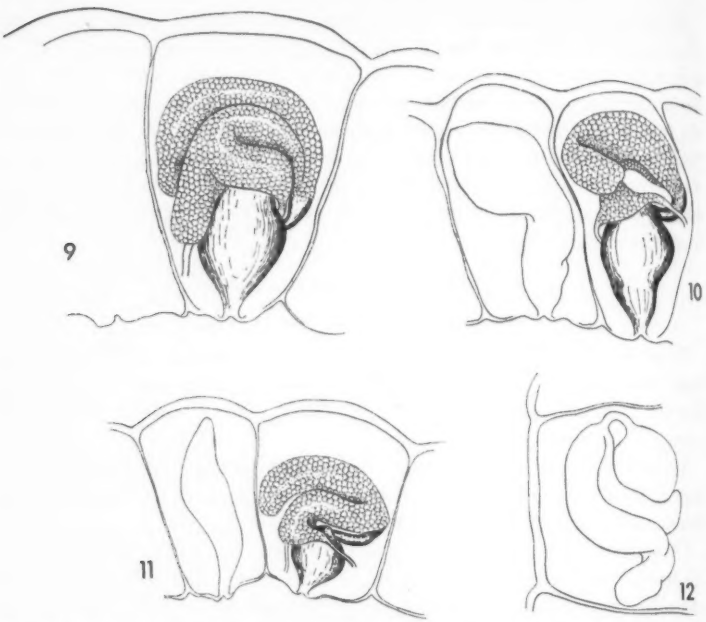
DIAGNOSIS.—A species of the Mesochorea group, distinguished not only from its close relatives but from all other species of the genus by the accentuated head size and small body.

DESCRIPTION.—A moderately large worm, maximum length about 3.5 mm., the body form unusual in not being appreciably enlarged near the midlength, but of essentially the same diameter throughout, the caudal sucker a little larger in diameter than the preceding few segments. Prosomites about twice as long as metasomites, but the two subsegments of about the same diameter.

Head enormously developed, about as long as the first five segments combined and half again as broad as the greatest body diameter. Peristomium rather small, less than a third of the total head length, and not flared, divided into dorsal and ventral halves with a small lobe at the lateral sinus on each side but the peristomial margin not lobed. Head broadest at its midlength, tapering slightly toward the ends, the diameter about 75 percent of the length.

Jaws anisomorphic, subhomodont, the dental formula 5–4; the lateral cusps not appreciably smaller than the dorsal median and ventral paramedian teeth.

Male reproductive system similar to that of *mesochorea* in most respects, but the prostate not noticeably longer than the spermiducal gland, both somewhat arched in the coelom with the ectal end of the latter drawn ventrad by the ejaculatory duct (perhaps also by the pressure of the rather short segment). Prostate a little greater in diameter than spermiducal gland, its size increasing a little entally, terminating in a bluntly clavate lobe. Ental end of spermiducal gland T shaped, both deferent ducts entering at about the same angle, into very weakly developed deferent lobes. Exact shape of bursa not



FIGURES 9–12.—Reproductive systems of three species of the Mesochorea section. 9, *Cambarincola ouachita*, new species, holotype, Chautauqua Co., Kansas. 10, *C. restans*, new species, holotype, Benton Co., Arkansas (spermiducal gland mostly concealed by the large prostate). 11, *C. mesochorea*, paratype, Perry Co., Indiana (ental end of spermiducal gland curved mesad and not visible in this aspect). 12, *C. mesochorea*, new species, specimens from Kinney Co., Texas, outline in dorsal aspect to show complete length of prostate gland.

clearly shown in any of the specimens, but apparently much like that of the other species, in this case nearly twice the diameter of the spermiducal gland; penial sheath moderately small and confined to the ental third of the bursa as usual.

Spermatheca very large and robust, consisting of a short, very broad, muscular ectal duct and an ovoid, expanded ental bulb, both of these parts much broader in relation to the size of segment v than in any other member of the genus. No glandular ental process observed.

VARIATION.—No appreciable variation in size or proportions was noted in the type series, all from a single collection.

AFFINITIES.—This species is clearly a member of the Mesochorea group, and closely related to both of the other two forms, but like *mesochorea* particularly in the shape and relative size of the prostate

and spermiducal gland. In this respect it represents an advancement over the strongly lobed gland of *ouachita*.

DISTRIBUTION.—Known only from the type locality. Presumably the species will be found to have a sporadic local distribution in the adjoining parts of Arkansas and Missouri.

REMARKS.—The name *restans* is from the Latin; its meaning "left behind, exiled" seems particularly appropriate for the denomination of this odd, archaic creature.

Cambarincola mesochorea, new species

FIGURES 6, 11, 12, 13

?*Branchiobdella americana* Pierantoni, 1912, Ann. Mus. Zool. Univ. Napoli, new ser., vol. 3, No. 24, p. 17.

Cambarincola vitrea (in part) Ellis, 1919, Proc. U.S. Nat. Mus., vol. 55, pp. 257, 258 (Douglas Lake, Michigan, record).

Cambarincola macrodonta (in part) Ellis, 1919, Proc. U.S. Nat. Mus., vol. 55, p. 257 (Morgan City, Louisiana, record).

TYPE SPECIMENS.—Holotype and four paratypes, USNM 29939, from *Orconectes* sp. collected in a small gravelly stream 1.5 miles east of Adyville, Perry County, Indiana, by P. C. Holt, July 28, 1958. Additional paratypes indicated in the list of material examined.

DIAGNOSIS.—A large species of the Mesochorea group characterized particularly by the very large prostate gland, which surpasses the spermiducal gland in both length and diameter. Spermiducal gland without a large subterminal posterior deferent lobe.

DESCRIPTION.—Body moderate to fairly large, ranging from 2.8-4.2 mm. in length, the greatest diameter occurring at segment VII, tapering gradually cephalad to segment I which is considerably narrower than the head; latter as long as the first three body segments combined; sucker appreciably broader than the two preceding segments, and as broad as the head.

Subsegments of the body of equal diameter, the prosomites about twice as long as metasomites. Most body segments of about the same length, except segment VII is longer than the others, and IX and X are slightly shorter.

Head rather long (about equal to first three body segments) and cylindrical, without subsegmentation except for the pronounced constriction at the base of the peristomium. Latter about a third the total head length and distinctly flared, its margin entire and unlobed. Jaws of moderate to fairly large size, subequal to each other in length and width, the dental formula 5–4.

Male reproductive system of moderate size, occupying about half of the area of one side of the sixth segment. Bursa small and subpyriform, as broad as long, or slightly broader; ejaculatory duct about

FIGURE 13.—Distribution of *Cambarincola mesochorea*. The records for Massachusetts unquestionably represent an adventitious occurrence, see discussion in text, p. 310.

equal to bursa in length, its diameter half or more the diameter of the spermiducal gland. Latter long and slender, entally somewhat enlarged and recurved ventrad over the bursa, the entry lobes of the deferent ducts terminal and equal in size. Prostate very large, at least as broad as spermiducal gland, usually of considerably greater diameter, and of equal length, its ental part normally curved mesiad under the gut and behind the spermiducal gland, and thus not visible. In normally distended specimens both the spermiducal gland and prostate lie oriented in a plane parallel to the median longitudinal axis of the body and extend the entire length of the coelom of segment VI.

Spermatheca rather slender, elongate, subfusiform, curving dorsolaterad around the gut, expanding laterally, and attenuated to a blunt ental process near the middorsal portion of the segment.

VARIATION.—Despite the rather extensive distribution of this species, I have been able to detect nothing of significance in the way of geographic variation in body form, jaws, or reproductive system. The single specimen seen from Louisiana differs somewhat from the

normal in having a distinctly broader ental portion of the prostate, as illustrated, but the quality level of this departure, particularly as seen in one specimen, cannot be given much attention at the present. It will, of course, be worthy of investigation when additional material is forthcoming from the lower Mississippi drainage.

Despite the apparent discontinuity involved, the specimens recorded from western Massachusetts do not vary in any way from the typical population of the species in Indiana.

DISTRIBUTION.—Records based upon specimens personally examined indicate a rather wide but perfectly coherent range over much of midland United States, from northern Michigan and South Dakota, Indiana, Kentucky, and Oklahoma to the coastal plain of Louisiana and Texas. No material has been examined from many of the States included in this general statement, but there is no doubt that future collections will establish the species in all of them, as well as extend the presently known periphery.

MATERIAL EXAMINED.—25 slides, from the following localities:

ARKANSAS: CRITTENDEN COUNTY: 14.6 miles south of Marked Tree, on U.S. Hy. 63, July 5, 1958, P. C. Holt (PCH 758). GREENE COUNTY: Roadside ditch along Ark. Hy. 25, 0.8 miles east of the Lawrence County line, July 5, 1958, Holt (PCH 759), MARION COUNTY: Fallen Ash Creek at Flippen, July 6, 1958, Holt (PCH 764).

INDIANA: CLAY COUNTY: 1.4 miles south of the Parke-Clay county line on Ind. Hy. 59, July 26, 1958, Holt (PCH 808). PERRY COUNTY: Small gravelly stream, 1.5 miles east of Adyville, U.S. Hy. 460, July 26, 1958, Holt (PCH 815, paratypes). SPENCER COUNTY: Sluggish muddy stream, 5.4 miles south of Chrisney on U.S. Hy. 231, July 27, 1958, Holt (PCH 817).

IOWA: DUBUQUE COUNTY: 9.9 miles north of St. Donatus on Iowa Hys. 28 and 67, May 12, 1956, Holt (PCH 896).

KANSAS: CHAUTAUQUA COUNTY: 4.3 miles west of the Montgomery County line, near Niotaze, July 8, 1958, Holt (PCH 773).

KENTUCKY: LOGAN COUNTY: Small stream at Diamond Spring, 5.7 miles north of Lewisburg on U.S. Hy. 430, July 27, 1958, Holt (PCH 821). MCLEAN COUNTY: 3.6 miles north of Livermore on U.S. Hy. 431, July 27, 1958, Holt (PCH 818).

LOUISIANA: ST. MARY'S PARISH: Lake Lapoudre at Morgan City, data and collector not indicated (USNM 17759). Identified as *C. macrodonta* by Max M. Ellis.

MASSACHUSETTS: BERKSHIRE COUNTY: Housatonic River drainage, Greenwater Pond, June 11, 1953, D. W. Crocker (PCH 577); also Lake Mahkeenac, same date and collector (PCH 578).

MICHIGAN: CHEBOYGAN COUNTY: Douglas Lake, July 1915, Max M. Ellis (USNM 17668). Labeled as paratype of *Cambarincola vitrea* by Ellis.

OKLAHOMA: COMANCHE COUNTY: Cache Creek at White Wolf Crossing, in Fort Sill, June 1, 1959, J. W. Berry (PCH 906). DELAWARE COUNTY: Small gravelly stream, 5.5 miles north of Jay, July 7, 1958, Holt (PCH 770).

SOUTH DAKOTA: BEADLE COUNTY: 6.6 miles west of the junction of Hys. 14 and 281, on U.S. Hy. 14, July 19, 1958, Holt (PCH 788). CODINGTON COUNTY: Watertown, July 19, 1958, Holt (PCH 789).

WISCONSIN: DANE COUNTY: Lake Mendota in Madison, August 28, 1949, A. A. Leath (PCH 262). JUNEAU COUNTY: 17 miles southeast of Mouston on U.S. Hy. 16, July 22, 1958, Holt (PCH 796).

Although these records give us but a general idea of the distribution, several inferences on peripheral limits can be drawn.

The distribution of the species in Kentucky appears to be essentially as now known. The rather intensive traverse of the State made by Dr. Holt in 1958 disclosed its presence in only two localities in the lower part of the Green River drainage. Further east, in Barren, Hart, and Edmondson counties, the species was apparently replaced by an abundant member of the Philadelphica group. The apparent absence of *mesochorea* from northern Indiana is more puzzling, there being no reason why the species should not occur in the headwaters of the Illinois River system. Yet the north-south traverse of western Indiana made by Dr. Holt in July 1958, failed to reveal specimens north of the latitude of Terre Haute. Clearly much more field work needs to be done in the States of Illinois, Indiana, and Michigan.

The records for western Massachusetts are almost certainly the result of the introduction by man of the common midwestern crayfish *Orconectes immunis*. Numerous collections from all parts of New York State made by Denton W. Crocker contain no specimens of *mesochorea*.

Presumably this species has a very wide range of ecological tolerance. It has been collected from numerous species of crayfishes in the genera *Procambarus* and *Orconectes*, in habitats ranging from natural and artificial lakes through roadside swamps and ditches to moderately cool gravelly streams. Whether *C. mesochorea* prefers a particular microniche on its hosts is at present unknown, but the question could easily be settled by an investigator collecting almost anywhere in the upper Mississippi Valley, where this species appears to be perhaps the most abundant member of its genus.

REMARKS.—The general body outline, head shape, and other characteristics give this species a strong superficial resemblance to *Cambarincola macrodonta* Ellis. It is not surprising that, relying upon jaw and body form for identification, Ellis should have misidentified a Louisiana specimen as *macrodonta*, but it is remarkable that he could have included such a conspicuously large-jawed creature as *mesochorea* among the paratype series of his own *vitrea*, which was diagnosed in part by its small and homodont jaws. Doubtless a number of existing literature records for *macrodonta* and *philadelphica* are actually based upon the present species. I have, however, made no attempt to piece together any information of this sort from published works.

The existence of Pierantoni's old name *Branchiobdella americana* constitutes the major threat to the validity of *mesochorea*. So far as the description goes, it applies quite well to *mesochorea*, *macrodonta*, *philadelphica*, and perhaps *chirocephala*. Reference of *americana* to the European genus *Branchiobdella* is surely based upon nothing more than Pierantoni's assumption of generic identity—*americana* being proposed prior to Ellis's establishment of the genus *Cambarincola*. As no material (aside from a single collection from New York reported by Goodnight) of a branchiobdellid with only one pair of testes has ever been seen from North America, and since recent morphological studies indicate that *Branchiobdella* is doubtless a Palearctic genus, I do not think that *B. americana* will prove to be other than some widespread and well-known species of *Cambarincola*. Pierantoni's types came from Texas and North Carolina and probably represent at least two species. Restudy of his slides and selection of a lectotype for the species may indeed show the priority of the name *americana* over *mesochorea*, but until this can be accomplished it is desirable to have a name available for the designation of this distinctive species.

MACROCEPHALA GROUP

The two species presently comprehended by this heading present such an array of basic similarities that their close relationship seems indisputable. One of the species is endemic to the Snake River drainage of Wyoming and Idaho, while the other is apparently localized in central Kentucky. Although the final word concerning the knowledge of this relationship remains to be written, some preliminary remarks may be of interest.

The group is characterized by (1) large size of body, and especially of the head, (2) a distinctive form of peristomial tentaculation, (3) short body segments of considerable diameter, having the effect, in the genital segments, of compressing the sex organs into a vertical alinement, (4) a large, globose bursa and relatively long ejaculatory duct, and (5) a very long spermiducal gland, entally bilobed at the entry of the deferent ducts.

Such characters are best appreciated by reference to illustrations, but attention is called in particular to the form of the peristomium. In most "tentaculated" species of the genus, the dorsal half of the peristomium is produced into four marginal lobes of greater or lesser dimension, the culmination being reached in *C. fallax* in which the lobes are fairly long and slender. In the present group, however, the tentacles are much more slender, and are submarginal in origin, resulting in a completely different appearance (see figures 15 and 18).

Key to Species of the Macrocephala Group

1. Ejaculatory duct very long, extending from bursa to nearly the middorsal region, spermiducal gland and prostate straight, extending dorsoventrally; head very large, up to a third the total length of the animal (Wyoming and Idaho) . . . . . **Cambarincola macrocephala** Goodnight

   Ejaculatory duct shorter, extending only halfway up the segment, the spermiducal gland and prostate thereby strongly bent, in their ectal third, downward to connect with it; head smaller, much less than a third of the total length (Kentucky) . . . . . **Cambarincola holti,** new species

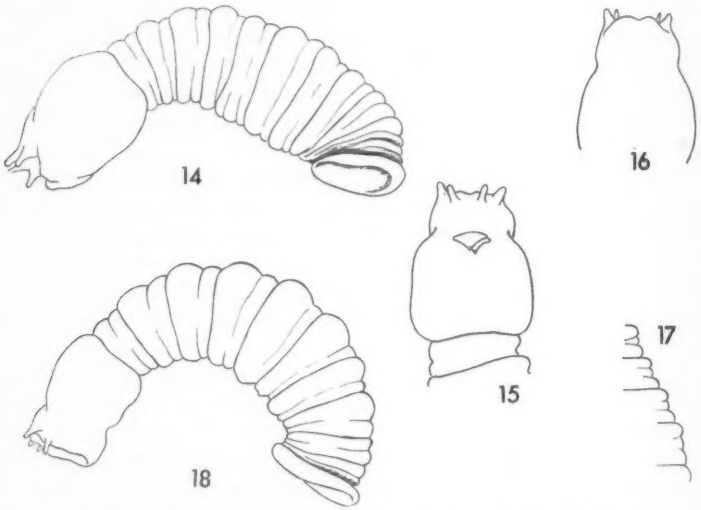
Cambarincola macrocephala Goodnight

FIGURES 14–17, 19

Cambarincola macrocephela [sic] Goodnight, 1943, Journ. Parasitology, vol. 48, p. 188.

Cambarincola macrocephala Holt and Hoffman, 1959, Journ. Tennessee Acad. Sci., vol. 34, p. 103.

TYPE SPECIMEN.—Holotype, USNM 20598, from *Pacifastacus g. gambelii* collected in Polecat Creek, northern Teton County, Wyoming, by Robert C. Brown, August 16, 1941. This large worm is mounted flattened dorsoventrally, and it is not possible to make out the reproductive systems with assurance.



FIGURES 14–18.—External appearance of two species of the Mesochorea section. 14, *Cambarincola macrocephala* Goodnight, lateral aspect, specimen from Gooding Co., Idaho. 15–17, *C. macrocephala,* type specimen, Teton Co., Wyoming: 15, Head in dorsal aspect with outline of jaws shown; 16, head in ventral aspect; 17, lateral profile of segments III–VI. 18, *C. holti,* lateral aspect, holotype, Pulaski Co., Kentucky.

DIAGNOSIS.—A large species of the Macrocephala group with a broad, enlarged head, tentaculate peristomium, isomorphic and similar jaws, large globose bursa, very long ejaculatory duct, long reflexed spermiducal gland with large symmetrically disposed ental deferent lobes, and an equally large reflexed prostate gland, extending ventrad to the level of the deferent lobes.

DESCRIPTION.—Maximum size of preserved worms, 4.8 mm. in length, 0.8 mm. in diameter at segment VII, and 1.1 mm. in greatest head width. Body outline of the usual profile, increasing in diameter up to segment VI, thereafter decreasing more abruptly to the penultimate segment.

Body segments very short in proportion to their diameter, the ratio about 4/1 to 5/1; prosomites about twice as long as metasomites and of slightly greater diameter.

Head very large, as long as the first five body segments combined (the entire anterior half of the body), its diameter as great as that of the broadest body segment. Peristomium not set off by a basal constriction nor strongly flared (at least in the material at hand), but divided into dorsal and ventral halves, the dorsal provided with four distinct slender submarginal tentacles, the ventral broadly bilobed.

Jaws large and robust, very similar in both size and shape, the dental formula 3–3; both jaws much wider than their length.

Male reproductive system large, occupying one entire side of the coelom of segment VI and extending mesad to the midventral and middorsal areas. Bursa very large and globose, as broad as long, the penial sheath occupying the ental half and normal in structure for the genus. Ejaculatory duct very long, extending dorsolaterad around the gut and somewhat dorsomesad to the junction of spermiducal and prostate glands. Both of the latter are then reflexed ventrad, curving around the gut down to the level of the penial sheath, where the spermiducal gland is evenly divided into two very similar deferent lobes which proceed ventromesad around the bursa to merge with the deferent ducts. Prostate similar in length and diameter to spermiducal gland, entally it is broadly rounded and completely overlaps the caudal deferent lobe.

VARIATION.—The available material from Idaho is quite homogeneous and presents only the size variation that one would expect in a single collection.

The holotype of *macrocephala*, mounted flat on a slide, differs somewhat from the specimens described in that the peristomium is set off by a basal constriction, with the tentacles somewhat smaller both in length and diameter. These differences may be due to preservation in strong alcohol. On the other hand, some of the anterior segments of the type specimen, notably from III through VI, are quite

distinctly tripartite, and suggest the condition upon which Goodnight founded a genus *Triannulata*. More caudal segments appear normal, e.g., with two subsegments.

RELATIONSHIPS.—The affinities of *macrocephala* lie rather clearly with the very similar *C. holti* from central Kentucky, which differs in its smaller size, particularly that of the head, and longer glandular organs of the male reproductive system. That the similarities of the two are due to convergence seems unlikely, and it is possible that we are here confronted with two relict forms of a parental stock which extended widely across North America during mid-Tertiary times.

DISTRIBUTION.—Known only from two widely separated localities in the upper part of the Snake River drainage. Collected, in addition to the type locality, at the following station:

IDAHO: GOODING COUNTY: Riley Creek at the Idaho Fish Hatchery, July 14, 1958, P. C. Holt (PCH 785). At this locality it occurred on *Pacifastacus gambelii connectans*.

REMARKS.—Assignation of the Idaho specimens to Goodnight's name *macrocephala* is made here with some reservation. Several differences shown by the type of the species have been noted in a preceding paragraph, and are illustrated in the accompanying figures. Until fresh topotypes of *macrocephala* are obtained for study, there will remain some doubt about its identity, but the general similarity of the worms from the two localities is so great that I think a conservative approach is warranted here. Although the male sex organs of the holotype can be seen only in dorsal aspect, they seem to correspond to those of the specimens from farther down the Snake River.

Presumably the original spelling "*macrocephela*" is due to a typographical error. The meaning, "long-headed" is particularly appropriate for a worm in which the head is one-third the entire length of the animal!

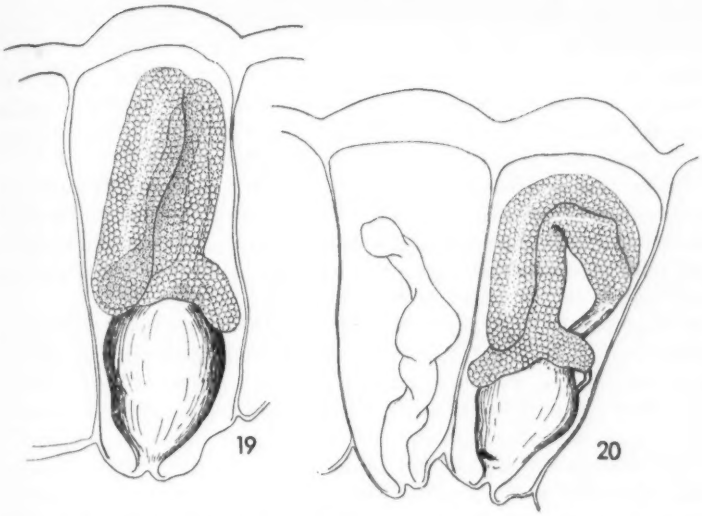
Cambarincola holti, new species

FIGURES 18, 20

TYPE SPECIMENS.—Adult holotype and paratypes of various ages, USNM 29940, from *Cambarus* sp. collected in a stream on the southern edge of Somerset, Pulaski County, Kentucky, by Perry C. Holt, July 28, 1958.

DIAGNOSIS.—A moderately large worm generally similar to *macrocephala* in body form and proportions, but distinct in the dental formula (5–4), abruptly flexed spermiducal and prostate glands, and characteristically shaped spermatheca.

DESCRIPTION.—Maximum size of preserved worms (holotype), 4.1 mm. in length, 0.9 mm. in diameter at segment VIII, 0.7 mm. in greatest head width. Body outline of the usual form, segments V-VII of es-



FIGURES 19, 20.—Reproductive systems, lateral aspect, of two species of the Mesochorea section. 19, *Cambarincola macrocephala* Goodnight, specimen from Gooding Co., Idaho. 20, *C. holti*, new species, paratype, Pulaski Co., Kentucky. Drawings to same scale.

sentially equal diameter; segment I the smallest. Body segments short, as little as a fourth the diameter at midbody, as much as a half at anterior end; prosomites large, about three times as long as metasomites. Caudal sucker large, its diameter greater than that of head.

Head larger than normal for genus, as long as first three body segments combined, and about a fourth the entire length of the animal, broader than the first segment but considerably narrower than midbody segments. Peristomium distinctly set off by a basal constriction, about a third of the total head length, with four slender elongate dorsal tentacles slightly removed from the peristomial margin, each subtended by a small rounded lobe.

Jaws large and massive, equal in size but anisomorphic, the dental formula 5–4 or 3–4.

Male reproductive system large, occupying most of one side of the coelom of segment VI as well as the midventral and middorsal areas. Bursa large and subglobose, a little longer than broad, merging entally into a short, slender, ejaculatory duct. Latter entering spermiducal gland at about the middle of the segment, the gland continuing dorsad for about a third of its length and then strongly bent on itself and directed ventrad to the level of penial sheath where

it bifurcates into the large deferent lobes which then proceed ventromesad into the deferent ducts. Prostate gland similar in length, diameter, and external appearance to the spermiducal gland, and likewise is directed entally first dorsad and then ventrad, crossing over the flexed part of the spermiducal gland in changing its direction; extending ventrad to level of the posterior deferent lobe.

Spermatheca is composed of three distinct sections: The basal or ectal half is an elongate, sinuous, muscular duct merging into a somewhat enlarged, subglobose, clear-walled ental bulb, this in turn gives origin to a smaller, tubular, and strongly glandular ental process, terminating in a rounded, somewhat swollen tip.

VARIATION.—This species is known only from a single collection of about a dozen worms, these vary among themselves only in size and proportions. In smaller worms, the dental formula is more consistently 5–4, the outermost lateral cusps of the dorsal jaw tending to be worn away in old specimens.

AFFINITIES.—Among known species of the genus, this one is obviously closest to *C. macrocephala*, and the differences between the two are largely set forth in the diagnoses and in the key. The presence of distinct tentacles will easily preclude confusion of *holti* with *mesochorea*, the only other eastern member of the section of comparable size and with very large, undifferentiated prostate gland.

DISTRIBUTION.—Known only from the type locality, "a medium large mountain stream" on the southern outskirts of Somerset, Kentucky. Perhaps it thus partakes of the characters of a more mountainous habitat than might be expected in south central Kentucky. It is unusual that numerous other collections made in the same general region on the same day did not yield specimens of this form. That it is endemic to a single stream seems unlikely, and the resolution of its distribution and ecology stands as a challenge to some future student of the genus.

REMARKS.—*C. holti* was taken in association with species in the genera *Pterodrilus* and *Xironodrilus*. The type specimen and some of the paratypes are rather heavily infested with stalked colonial peritrich protozoans, much more than any other specimens examined during this study.

BRANCHIOPHILA GROUP

This group embraces two species of somewhat dissimilar worms, and may have to be abandoned when the genus becomes better known. Both of the species are small and although generally similar in structure may not share a common origin.

In this group the spermiducal gland is of normal relative size and proportions, and produced into a large terminal or lateral posterior

deferent lobe. The prostate is rather short and histologically similar to the spermiducal gland. There are no appreciable specializations aside from the modification of the nominotypical species for inhabiting the branchial chambers and gills of the crayfish.

It is here that we encounter extremely localized forms: Each of the species is known only from one locality. Their specific distinctness certainly suggests that they must be relicts of a former wide-ranging stock, rather than recent derivatives of an existing progenitor.

Cambarincola branchiophila Holt

FIGURES 23, 24

Cambarincola branchiophila Holt, 1954, Virginia Journ. Sci., new ser., vol. 5, pp. 168–172, figs. 1–5.—Holt and Hoffman, 1959, Journ. Tennessee Acad. Sci., vol. 34, p. 103.

TYPE SPECIMENS.—Holotype, USNM 25855, from *Cambarus bartonii* and *C. sciotensis* collected in Sinking Creek, Giles County, Virginia (one mile west of Newport), by P. C. Holt, F. D. Kiser, and Cornelia Tuten, July 3, 1950; topoparatypes, PCH 407, from the same collection.

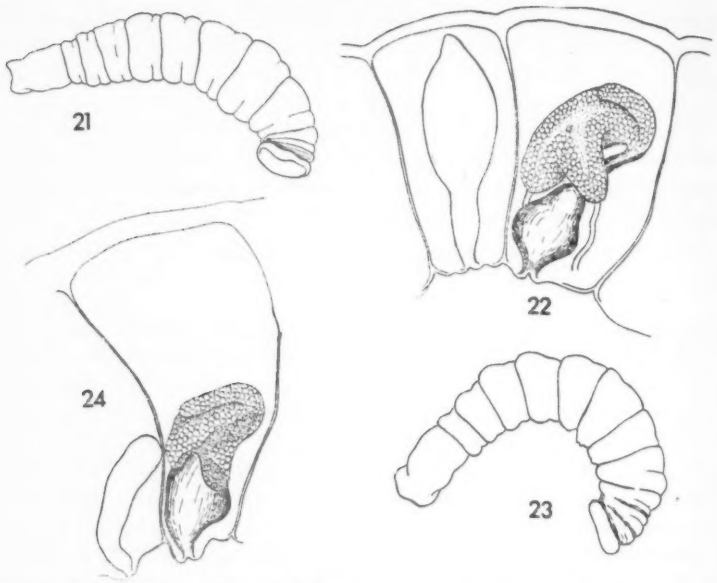
DIAGNOSIS.—A moderately large species of its group, characterized by the stout body form, 5–5 dental formula, and generally reduced male reproductive system, without the strongly shortened prostate gland which characterizes *Cambarincola shoshone*.

DESCRIPTION.—Body stout, up to about 3.5 mm. in length, segment I narrowest, following segments increasing up to VI and VII which are twice the diameter of I; last three body segments abruptly decreasing in size, caudal sucker subequal in diameter to segment I. Segments short, the prosomites about twice the length of metasomites but not elevated above them.

Head relatively small, only slightly longer than broad; its diameter less than that of segment I; peristomium set off by a distinct basal constriction, flared but with entire margins, no evidence of lobes in preserved specimens. Basal portion of head subdivided by a slightly impressed constriction and thereby appearing superficially tripartite in profile.

Jaws small, essentially isomorphic; heterodont, the dental formula 5–5 with the paramedian cusps of each jaw slightly smaller than the large median and outer dentations.

Male reproductive system reduced in overall size and confined to the lower third of one side of the segment. Bursa obovate to fusiform, about as long as the slender ejaculatory duct; spermiducal gland small, somewhat flattened, with two subequal deferent lobes; prostate gland fairly broad, slightly enlarged entally, extending as far as the sinus between the deferent lobes.



FIGURES 21–24.—Structural details of two species of the Mesochorea section. 21, *Cambarincola shoshone*, new species, paratype, Gooding Co., Idaho; 22, the same, reproductive systems in lateral aspect. 23, *C. branchiophila* Holt, paratype, Giles Co., Virginia; 24, the same, reproductive systems in lateral aspect. Figures 21, 23 and 22, 24 drawn to same scales.

Spermatheca simple, a slender tubular structure, with a fairly short, muscular ectal third and a slightly thicker glandular ental two-thirds; no ental process present.

VARIATION.—The only appreciable variation observed in the small number of worms available from the type locality affects the proportions of the bursa, specifically its length to diameter ratio. Presumably such variation is a consequence of muscular reaction to preservation.

AFFINITIES.—Superficially this species bears a strong resemblance to *C. shoshone*, although the similarity may be a result of convergence. In my opinion, *C. branchiophila* is a relict of some extinct ancestral stock, and does not have any really close relatives among the known existing species.

DISTRIBUTION.—Known only from the type locality, but certainly to be expected elsewhere in the Kanawha River drainage of southwestern Virginia.

REMARKS.—In the original description, Holt cites some measurements of interest. He found that the deferent ducts of this species

approximate 23 microns in diameter, while those of the somewhat larger *C. philadelphica* attained a diameter of only 14 microns in a considerable series of specimens measured. Probably the conversion of this data into some common ratio—such as duct diameter in relation to jaw length—would produce an even more dramatic separation.

This is the only member of the genus known to be branchiophilus, although *C. demissa* presumably is also. In general, our knowledge of such species is very deficient, owing to the usual necessity of dissecting the crayfish to extract and examine the gill tissue, and it is entirely reasonable to assume that greater attention to this neglected phase of collection will result in the discovery of additional gill-inhabiting forms.

Cambarincola shoshone, new species

FIGURES 2, 21, 22

TYPE SPECIMENS.—Holotype and three paratypes, USNM 29941, from *Pacifastacus gambelii connectans* collected in Riley Creek in the Idaho Fish Hatchery near Hagerman, Gooding County, Idaho, by Perry C. Holt, July 14, 1958. Topoparatypes from the same collection, PCH 785.

DIAGNOSIS.—A small species tentatively referred to the Branchiophila group, characterized by the distinct and equal-sized deferent lobes, the very short prostate, the very small, isomorphic, homodont jaws, and the graceful, even, body profile.

DESCRIPTION.—Maximum length, 1.8 mm., body smallest at segment I, gradually increasing in diameter to segment VII which is also the longest; caudal sucker moderate to large, wider than head or segment I, equal in diameter to segment II. Prosomites only about twice as long as metasomites, and of the same diameter, the intersegmental groove very weakly defined.

Head small, slender, about as long as first three body segments combined, narrower than segment III, distinctly divided into three subsegments by constrictions; peristomium set off by a very pronounced basal constriction, somewhat flared, divided into a small dorsal and a much larger ventral half but otherwise entire and not provided with dorsal lobes.

Jaws very small, less than 6 percent of the head length, isomorphic and homodont, the dental formula 3–3, each tooth large and conspicuous.

Male reproductive system of moderate size, extending dorsad as far as level of gut. Bursa of average relative size, strongly expanded from a narrow ectal portion, the circular muscle region enlarged; penial sheath likewise somewhat expanded as seen in profile. Ejaculatory duct fairly long and slender, shorter than length of bursa.

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Spermiducal gland larger than bursa, entally divided into two large, subequal deferent lobes, the posterior lobe directed caudoventrad and concealing ectal half of the ejaculatory duct and apex of penial sheath. Prostate quite slender and short, its histology similar to that of spermiducal gland, no terminal bulb detected.

Spermatheca tripartite, consisting of a slender muscular ectal duct, a somewhat translucent, globosely enlarged median sperm reservoir, and an abruptly set-off glandular ental process.

VARIATION.—All of the specimens examined are essentially similar in structural features, varying chiefly in size. The bulbar portion of the spermatheca varies considerably in its relative size and globosity, from merely fusiform to nearly sphaeroid appearance.

AFFINITIES.—Of the known species of the genus, *shoshone* appears to be structurally most like *branchiophila*. That the relationship is due to convergence cannot, however, be discounted. Here the matter must rest until additional species have come to light.

DISTRIBUTION.—Known only from the type locality, a tributary of the Snake River in the southwestern part of Idaho.

PHILADELPHICA SECTION

The species comprehended in this major subdivision of the genus include the most widespread and frequently encountered forms. Most of them are already known from a considerable number of localities, although a few appear to be localized. Resolution of specific identities in this section has proved to be the major problem in the revision, as the species in the Philadelphica group are generally similar and difficult to separate.

This section is characterized by the form of the male reproductive system. The prostate is histologically quite different from the spermiducal gland, being composed of large cuboidal cells containing little or no granular material and apparently with no well-defined nuclei. Entally, the prostate terminates in a clear bulbous development, the function of which is still unknown. Possibly it is related to some hydrostatic function of the prostate, as the relative size varies slightly in different individuals.

Within the limits set by the preceding definition, there is considerable variation in body form, size, jaw structure, and details of the sex organs. The range of variability in each category is as great as observed for the entire genus, reflecting perhaps considerable evolutionary radiation subsequent to the differentiation and specialization of the prostate, but in general the overall facies of all the species is basically similar and leaves little doubt about the homogeneity of the section.

As now understood, the twelve species may be conveniently allocated into five groups on the basis of characters taken in combination and indicative of close affinities.

Key to Groups of the Philadelphica Section

1. Prostate gland very long, much exceeding length of the spermiducal gland. (fig. 34), its terminal third slightly twisted or sinuate; very large species. INGENS GROUP (p. 333)

   Prostate gland never longer than the spermiducal gland and often much shorter; small to moderate-sized species 2

2. Spermiducal gland with a very large lateral (posterior) deferent lobe (fig. 36); prostate terminating in a somewhat rudimentary bulb. VIRGINICA GROUP (p. 321)

   Spermiducal gland without a conspicuous posterior deferent lobe; prostate terminating in a conspicuous bulb 3

3. Spermiducal gland very long, its ental half reflexed closely upon the ectal half; in lateral aspect this gland together with the prostate assuming a distinctly sigmoid alshape . . . . . VITREA GROUP (p.323)

   Spermiducal gland shorter, often strongly curved but never with the ental half turned back against the ectal half 4

4. Jaws strikingly dissimilar, the dorsal about eight times the bulk of the ventral; prostate gland about half as long as spermiducal gland or less; general size of the male reproductive system reduced; body size small to moderate. HETEROGNATHA GROUP (p. 361)

   Jaws either identical in size and shape, or anisomorphic with the dorsal jaw slightly the larger; prostate at least half as long as the spermiducal gland; reproductive system normal in size for the genus; body size moderate to large . . . . . PHILADELPHICA GROUP (p. 336)

VIRGINICA GROUP

This group is proposed to accommodate an interesting small worm, herein described as new, which casts some light on the possible antecedents of other members of the section. *Cambarincola virginica*, at first sight, appears to be related to *ouachita* and to *branchiophila* because of the large posterior deferent lobe of the spermiducal gland, yet magnification reveals that the prostate is distinctly differentiated and that the terminal bulb is present, in a rudimentary form. The jaws of this species are quite similar to those of species in the Vitrea group.

I suggest that in this worm we have an approximation to the ancestral form of the Philadelphica section shortly after the basic dichotomy which has given rise to the three major sections of the genus. The posterior deferent lobe is doubtless a primitive character which has become increasingly suppressed through the Philadelphica section concomitant with the emphasized differentiation of the prostate, and, also, the gradual reduction in bulk of the sex organs.

It is likewise a matter of interest that the species occurs in an area both geographically and ecologically remote from the main center of speciation in eastern United States.

Cambarincola virginica, new species

FIGURES 35, 36

TYPE SPECIMENS.—Holotype and paratype, USNM 29942, from *Cambarus acuminatus* collected in a small slow stream 4.7 miles north of Petersburg, Chesterfield County, Virginia, by P. C. Holt and M. L. Bobb, May 31, 1949.

DIAGNOSIS.—With the characters of the group, easily recognized within the genus by the combination of a specialized prostate with small terminal bulb and a large lateral deferent lobe near the middle of the spermiducal gland. The spermatheca is very long and slender, extending to the middorsal region.

DESCRIPTION.—A moderately small worm, up to 2.0 mm. in maximum length, the body profile very slightly fusiform with the greatest diameter at segment VII, gradually tapering toward each end; prosomites only slightly longer than metasomites and of about the same diameter. Caudal sucker wider than segment I and head.

Head rather small and short, only slightly longer than broad, of the same diameter as segment I, peristomium set off by a basal groove and somewhat flared, but essentially with entire margins. Jaws small, anisomorphic but equal in size, dental formula 5–4, teeth virtually subequal in size and shape, the median dorsal or paramedian ventral teeth slightly the largest.

Male reproductive system large, filling one side of the segment lateral to the gut. Bursa elongate fusiform, 1.5 to 2 times as long as broad, about equally divided into atrium and penial sheath, merging abruptly into the slender ejaculatory duct. The latter a little more than half as long as bursa, and slightly enlarged at its midlength. Spermiducal gland large, directed obliquely cephaloventrad across the segment, extending down to the level of midlength of the bursa, thence merging into the anterior deferent lobe which proceeds mesad into the segment. Posterior deferent lobe large and distinct, from the midlength of the gland, directed caudad and concealing most of the ejaculatory duct, beyond which it is bent abruptly ventromesad, merging into the posterior deferent duct. Prostate gland about two-thirds the maximum diameter of the spermiducal gland, but less than half its length, composed of large vacuolated cuboidal cells very different from the cells of the spermiducal gland; terminating in a small and inconspicuous clear space doubtless homologous with the large bulb of the Philadelphica group.

Spermatheca elongate, slender, extending up around the gut as far as the middorsum of the coelom, not appreciably enlarged along its length but divided into three general regions, viz, an ectal glandular spermathecal duct, a median (presumably distendable) bulbar portion, and an ental process composed of thick cuboidal epithelium.

VARIATION.—The small quantity of specimens examined is essentially homogeneous in all diagnostic characters.

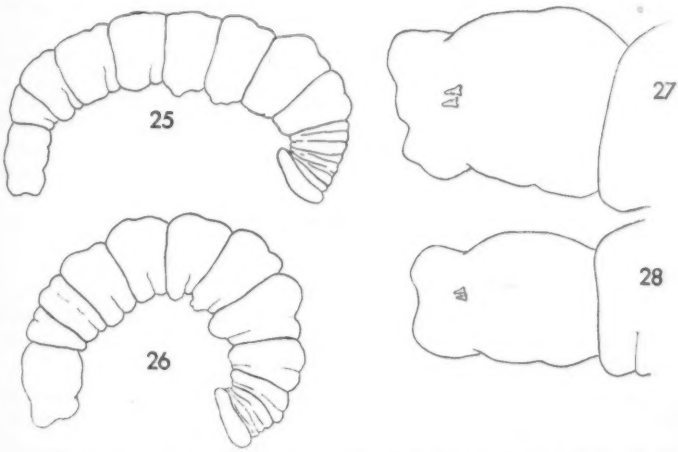
AFFINITIES.—Not closely related to other members of the section. The gross appearance of the genital organs is somewhat like that of some species of the Mesochorea section, notably *Cambarincola ouachita*, but the histology of the prostate is an easily seen fundamental distinction.

DISTRIBUTION.—Known only from several streams in the Fall Line belt in eastern Virginia, to which region it may perhaps be endemic. Aside from the type locality, specimens of this species are at hand from one additional station:

VIRGINIA: CHESTERFIELD COUNTY: Stream below the lake in Camp Shawandasee, May 14, 1949. P. C. Holt (PCH 211), from *Cambarus acuminatus* Faxon.

VITREA GROUP

The two species referred to this group are quite similar in most respects and may eventually be shown to be geographic races of a single, wide-ranging form.



FIGURES 25–28.—Structural details of two species of the Vitrea group. 25, *Cambarincola vitrea* Ellis, specimen from Sumner Co., Kansas. 26, *C. osceola*, new species, specimen from Calhoun Co., South Carolina. 27, *C. osceola*, head in lateral aspect, jaws shown in outline, 7.8 percent of head length. 28, *C. vitrea*, head in lateral aspect, specimen from Beadle Co., South Dakota, jaws shown in outline, 4.8 percent of head length.

The outstanding characteristics of the Vitrea group lie in (1) the anisomorphic, essentially homodontous small jaws, and (2) the strongly sigmoid shape assumed by the thick prostate and the long, reflexed spermiducal gland.

Whether actually two different species, or only subspecies, the two forms of this group are interesting in exhibiting a certain amount of geographic variation in the jaw size and proportions. As discussed at length under the treatment of *C. osceola*, the size of the jaws relative to head length varies in a general gradient from northwest to south and thence northeast again. Furthermore, over most of the combined range, the ventral jaw is subequal to the dorsal or slightly longer, while in the northern segment of *osceola* the dorsal jaw becomes distinctly longer than the ventral.

The ranges of both forms coincide generally with lowland habitats, a circumstance which in many cases appears to enhance wide distribution by affording a sort of ecological continuity.

The following key will separate 100 percent of the specimens which have been examined. The future student of this group is cautioned that well-preserved specimens are essential for making accurate measurements, and that material from the Gulf Coast States may be expected to show some degree of intermediacy.

Key to Species of the Vitrea Group

1. Prostate gland larger in diameter, from 70–90 percent of the diameter of the spermiducal gland at the base, averaging 82 percent; length of longest jaw 5–7 percent the length of the head (interior United States in the Mississippi River drainage . . . . . **Cambarincola vitrea** Ellis

   Prostate gland smaller in diameter, from 50–70 percent of the diameter of the spermiducal gland at the base, averaging 56 percent; length of longest jaw 7–9 percent of the head length (Atlantic and Gulf Coastal Plain region). **Cambarincola osceola,** new species

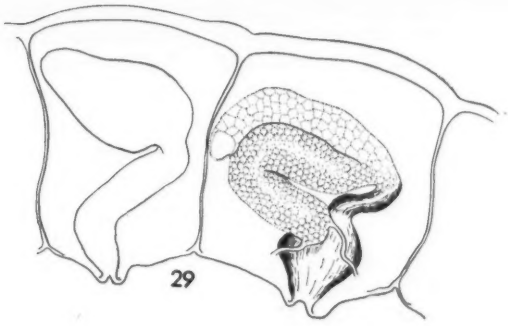
Cambarincola vitrea Ellis

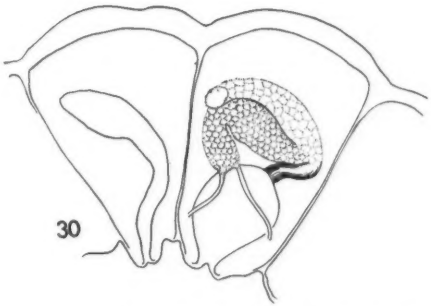
FIGURES 25, 28, 29, 31

Cambarincola vitrea Ellis, 1918, Pap. Michigan Acad. Arts Sci., vol. 37, p. 51; 1919, Proc. U.S. Nat. Mus., vol. 55, p. 249.—Goodnight, 1940, Illinois Biol. Monogr., vol. 17, No. 3, p. 33; 1943, Journ. Parasitology, vol. 48, p. 188.—Holt and Hoffman, 1959, Journ. Tennessee Acad. Sci., vol. 34, p. 103.

TYPE SPECIMEN.—Holotype, USNM 17667, from *Orconectes immunis* collected at Douglas Lake, Cheboygan County, Michigan, by Max M. Ellis in July 1915. This specimen is mounted flattened dorsoventrally, showing the jaws clearly; the reproductive systems are obscured, however.

DIAGNOSIS.—A moderate-sized member of the genus, easily recognized by the characters of the body form, jaws, and especially the





FIGURES 29, 30.—Reproductive systems of two species of the Vitrea group. 29, *Cambarincola vitrea* Ellis, specimen from Dane Co., Wisconsin. 30, *C. osceola*, new species, specimen from Southampton Co., Virginia.

strongly sigmoid spermiducal gland of the male reproductive system and the elongate spermathecal duct with a small globose ental bulb.

DESCRIPTION.—Moderate in body size, ranging from 1.9 to 2.6 mm. in length, the greatest diameter occurring at segment VII which is only slightly broader than segments V and VI; prosomites only of very little or not of greater diameter than the metasomites.

Head somewhat smaller than average for the genus, equaling segment I or less in diameter, its length somewhat less than diameter of segment VII. Peristomium distinctly set off by a constriction, flared, both upper and lower major lobes simple; ventral side of head usually with an additional transverse constriction near the base.

Jaws small, heterodont, dissimilar in dorsal aspect with a 5–4 dental formula but very similar in lateral aspect and approximately of the same size. Dorsal jaw with five widely separated acute cusps of which the median and two paramedian members are of about the same size, the two lateral cusps slightly smaller. Ventral jaw with

four similar dentations, the paramedians a little larger than the laterals. In lateral aspect the dorsal jaw averages 6.1 percent of the total head length, with variation from 4.8–7.2 percent.

Body of normal proportions for the genus, segment I somewhat broader than head diameter, the body increasing gradually back to segment VI and VII, thence tapering rather abruptly to X which is distinctly narrower than the caudal sucker. Latter fairly large, either equally (rarely) or slightly exceeding (usually) the greatest head diameter.

Male reproductive system (fig. 29) fairly large in its relative size, occupying most of one side of segment VI. Bursa pyriform or subcordate in shape, 1.5 times as long as broad or even less. Atrial portion shorter than penial sheath. Ejaculatory duct short and narrow, one-half to two-thirds as long as bursa and about a fourth as wide. Spermiducal gland very long and abruptly reflexed at the midlength, the ental half lying beside and against the ectal with the ental end overlapping the bursa. No enlargement or lobation of the gland at points of entry of the very slender deferent ducts. Prostate relatively short and slender, less than two-thirds as long as spermiducal gland, and about three-fourths its diameter, with a well-defined terminal bulb.

Spermatheca elongate and slender, curving dorsolaterad around the gut in segment V and attaining the middorsal interior wall of the segment. Basal two-thirds composed of the parallel-sided and slender spermathecal duct, the ental third of the globose or fusiform spermathecal bulb. No ental glandular process present.

VARIATION.—A certain amount of variation affecting the relative size and proportions of the sexual organs was detected, but none of it appears to be associated with any sort of morphocline. A possible geographic gradient may affect the jaw size—specimens from Kansas have appreciably larger jaws which measure from 6–8 percent of the head length, whereas worms from Wisconsin and South Dakota (somewhat larger in total size) have jaws with a length only 5 percent that of the head. Presumably material from the intervening region will be found to be intermediate in this respect. The shape of the jaws is not affected by this variation in size. A summary of selected measurements is appended in a following table which compares this form with *C. osceola*.

AFFINITIES.—The only close relative of *vitrea* is the form hereinafter described under the name *osceola*. So far as existing material goes, *osceola* differs clearly from *vitrea* in jaw size and details of the sex organs, but the accumulation of specimens from the Gulf Coast region may reveal the presence of intermediate populations.

FIGURE 31.—Distribution of the two species of the Vitrea group. ○, *Cambarincola vitrea;* ●, *C. osceola.* Symbols represent the localities from which specimens have been examined; no literature records included.

DISTRIBUTION.—On the basis solely of material personally examined, *vitrea* is found to be widely distributed in the upper Mississippi Valley and Great Lakes region, and various published records (some doubtless incorrect) extend the range even more broadly. As presently known, the range of *vitrea* extends from the Red River in Arkansas north to the Great Lakes, and from Michigan and Illinois west to the foothills of the Rockies.

Presumably the species may be found in Indiana, but it was not represented in any of the collections made by Dr. Holt in a north-south traverse of that State in 1958. It may be found that the population of northern Michigan arrived by crayfish from the west across the Straits of Mackinac during the postglacial occupation of Wisconsin.

Future collectors will have plenty to do in rounding out our knowledge of the distribution of this easily recognized species. Existing confirmed records are those of the following collections:

COLORADO: BOULDER COUNTY: St. Vrain's Creek near Boulder, May 1915, Max M. Ellis (USNM 17670, 4 slides). YUMA COUNTY: Arikaree River near Beecher's Island, October 1915, B. Jaffa (USNM 17677, 2 slides).

OKLAHOMA: COMANCHE COUNTY: Fort Sill, June 6, 1959, J. W. Berry (PCH 905).

ARKANSAS: BENTON COUNTY: Wildcat Creek at Ark. Hy. 68, July 7, 1958, P. C. Holt (PCH 769). CRITTENDEN COUNTY: 14.6 miles south of Marked Tree on U.S. Hy. 63, July 5, 1958, Holt (PCH 758). GREENE COUNTY: 0.8 miles east of the Lawrence County line on Ark. Hy. 25, July 5, 1958, Holt (PCH 759).

KANSAS: CHAUTAUQUA COUNTY: 4.3 miles west of the Montgomery County line on Kans. Hy. 166, July 8, 1958, Holt (PCH 773). LYON COUNTY: 3.5 miles west of Emporia, June 2, 1944, Zirnstein (PCH 182). SUMNER COUNTY: 5.6 miles north of South Haven on U.S. Hy. 81, July 8, 1958, Holt (PCH 775).

ILLINOIS: CHAMPAIGN COUNTY: Urbana, Frank Smith (USNM 17676). IROQUOIS COUNTY: Wellington, September 1914, A. T. Stevens (USNM 17675).

MICHIGAN: CHEBOYGAN COUNTY: Douglas Lake, summer 1915, Max M. Ellis (USNM 17668, paratypes, 17673, 17675).

MINNESOTA: OLMSTEAD COUNTY: 5.9 miles west of Eyota on U.S. Hy. 14, July 21, 1958, Holt (PCH 792). WRIGHT COUNTY: Clearwater River at Minn. Hy. 152 in town of Clearwater, July 21, 1958, Holt (PCH 793).

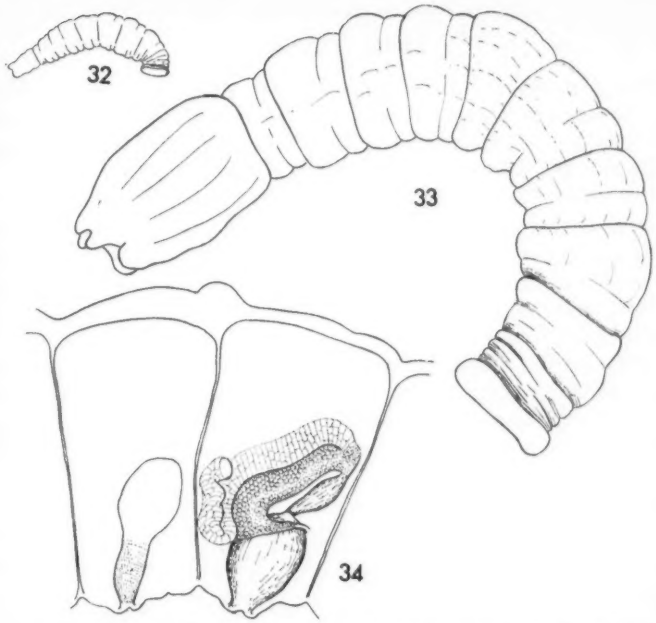
WISCONSIN: DANE COUNTY: Lake Mendota in Madison, August 28, 1949, A. A. Leath (PCH 262). GRANT COUNTY: Blake Fork, on Wis. Hy. 35 near Bloomington, May 13, 1956, Holt (PCH 900). JUNEAU COUNTY: 17 miles southeast of Mauston on U.S. Hy. 16, July 22, 1958, Holt (PCH 796). ONEIDA COUNTY: Rhinelander, October 1915, G. Hanson (USNM 17669, 5 slides).

SOUTH DAKOTA: BEADLE COUNTY: 3.4 miles east of Wessington on U.S. Hy. 14, July 19, 1958, Holt (PCH 788).

REMARKS: This widespread and often abundant species was originally described in the body of a key to four species of branchiobdellids collected by Ellis in Michigan, with the indication that the formal description was then in progress. The name *vitrea* is usually cited as dating from 1919, although the earlier usage constitutes a valid proposal of a new name, containing as it does considerable comparative description with related forms and general indication of a type locality.

In the following year the complete description of *vitrea* was published, including a photograph of the entire animal, drawings of the jaws, and an imposing list of localities from the Middle West and Great Plains areas. The species appears not to have been mentioned again in the literature until the publication of Goodnight's summary of 1940, which merely quotes the original description with its published localities, and adds 23 new localities for the species. The only new and original commentary contributed is the remark that "This form could be confused with *Cambarincola macrodonta* but it is easily distinguished by the difference in tooth structure as outlined above." Presumably the dimension of 310 mm. cited by Goodnight for the holotype is a misprint for Ellis's original figure of 3.0 mm.

In three other short papers, Goodnight has recorded *vitrea* from Georgia (1940b), Florida (1941), and Wyoming and Michigan (1943).



FIGURES 32–34.—Structural details of two species of *Cambarincola*. 32, *C. shoshone*, new species, body profile, drawn to same scale as next figure to show difference between the smallest and largest species in the genus. 33, *C. ingens*, new species, body in lateral aspect, paratype, Giles Co., Virginia; 34, reproductive systems of the same specimen.

Woodhead (1950) has published a figure of a branchiobdellid from Michigan identified by him as *vitrea*, but it is obvious that his species is not even congeneric with Ellis's.

Ellis emphasized a superficial resemblence in body form between *vitrea* and *Xironodrilus formosus*, in which I concur. He also pointed out, correctly, the distinctive characters of the small, acutely toothed jaws, but curiously enough one of his paratypes from Douglas Lake is a perfectly typical specimen of the new species *C. mesochorea*, having jaws entirely different in size and shape from the other specimens of the type series!

The name *vitrea* was given by Ellis with reference to the glassy appearance of the body wall of the type material. This may be a characteristic of the species in life, but in the preserved specimens which I have seen there is nothing unusual about the texture of the integument.

Cambarincola osceola, new species

FIGURES 26, 27, 30, 31

TYPE SPECIMENS.—Holotype and seven paratypes, USNM 29943, from *Procambarus paeninsulanus* and *Cambarus uhleri* collected along Dry Creek, 3.1 miles north of Iron City, Seminole County, Georgia, by Horton H. Hobbs and C. W. Hart, September 9, 1955.

DIAGNOSIS.—A small species of the Vitrea group, very similar to the typical species and possibly a geographic race of it, but differing in the much smaller diameter of the prostate in comparison with that of the spermiducal gland, as well as by differences in the jaw sizes at least in the populations of the two that are geographically most approximate.

DESCRIPTION.—Essentially similar in body form to *C. vitrea*, averaging perhaps somewhat larger (2.8 mm. in maximum length). Segments slightly more uniform in diameter, although the midbody segments (V–VII) are the largest; caudal sucker generally smaller than the head diameter.

Head larger than in *vitrea*, equaling or exceeding diameter of segment I, its length equal to diameter of segment VII. Peristomium distinctly set off and flared, its margin entire except for division into dorsal and ventral halves.

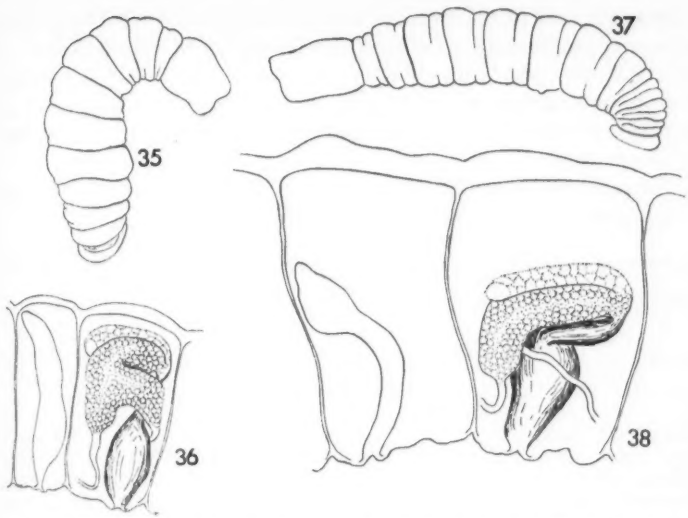
Jaws larger than in *vitrea* although of similar form, i.e., anisomorphic, pentatetradont, the individual teeth well separated and essentially homodont. In lateral aspect the jaws elongate and slender, the lateral cusps elevated and distinct. In specimens from Florida and Georgia, the jaws are subequal in length or the ventral jaw is longer; in more northern material (South Carolina to Virginia) the relationship is reversed with the dorsal jaw distinctly the longest.

Male reproductive system similar to that of *vitrea* in most respects, differing chiefly in the lesser diameter of the prostate gland in comparison with the spermiducal gland: from 50-70 percent the diameter of the latter as against 70-90 percent in *vitrea*.

Spermatheca with an elongate, slender, ectal duct which extends into the dorsal half of the coelom and a slightly enlarged ental bulb, the latter generally of greater size than in *vitrea*.

VARIATION.—Most of the observed variation within the limits of this form affect the actual and relative size of the jaws with respect to head length. Similar variation has been remarked in the treatment of *C. vitrea*.

In the population of southern Georgia and adjacent northwest Florida, the jaws are either of equal median length or the ventral jaw is slightly the longer, and averages from 6-8 percent of the total head length. In the segment of the species which occurs in Virginia



FIGURES 35–38.—Structural details of two species of *Cambarincola*. 35, *C. virginica*, external appearance of holotype, Chesterfield Co., Virginia (somewhat distorted in preservation); 36, the same, reproductive systems in lateral aspect. 37, *C. macrodonta* Ellis, lateral aspect of paratype, Boulder Co., Colorado; 38, the same, reproductive systems in lateral aspect.

and the Carolinas, the dorsal jaw is invariably the longer, amounting to 8 or 9 percent of the head length. There is unfortunately nothing available in the way of good material from north Georgia, so we cannot say whether this variation represents merely a north-south gradient or whether some break in the distribution of the character occurs (as possibly at the Savannah River). It will be recalled that in *vitrea*, variation in the ratio of jaw length to head length proceeds in just the opposite direction, the jaws becoming smaller in going north from Arkansas to North Dakota.

This relationship casts an interesting reflection in the matter of the status of *vitrea* and *osceola*. In the former population (and assuming the two to be allopatric species), the jaw size increases from the farthest periphery toward the general direction of *osceola*, in the latter, the jaws decrease in size in going from Virginia south and west in the direction of *vitrea*. There is perhaps an even continuum of the 6-8 percent ratio between the populations of the Ozarks on one hand and west Florida on the other, which, if proved, would result in a great crescent ranging from North Dakota to southeastern Virginia, with the JL/HL ratio only 5 percent at one extreme, but increasing to 9 percent at the other.

Alabama and Mississippi, as well as Georgia, are thus the areas of primary significance in the eventual resolution of this problem. At least the first two States mentioned should also contain specimens the prostate glands of which are intermediate in size, if the two species here considered are actually only geographic races of a single, far-flung species.

The reproductive systems do not vary appreciably within the range here assigned to the nominal species *osceola*.

Summary of variability in several structural characters in the species of the Vitrea *group*

Dimension	*Vitrea*		*Osceola*	
	Mean	Range	Mean	Range
Body length (mm.)	2. 35	(1.91–2.62)	2. 34	(1.67–2.78)
Maximum diameter (mm.)	0. 41	(0.32–0.52)	0. 42	(0.34–0.60)
Head length (mm.)	0. 38	(0.32–0.48)	0. 41	(0.32–0.56)
Head diameter (mm.)	0. 26	(0.21–0.32)	0. 29	(0.25–0.36)
Sucker diameter (mm.)	0. 28	(0.20–0.34)	0. 30	(0.22–0.40)
Diameter of spermiducal gland at base (microns)	62	(44–72)	60	(46–80)
Diameter of prostate gland at base (microns)	50	(36–60)	33	(20–46)
Diameter of ental bulb of spermatheca (microns)	92	(70–140)	56	(32–80)
Jaw length divided by head length (%)	8. 1	(4.8–7.3)	8. 2	(7.2–8.8)

DISTRIBUTION.—From extreme southeastern Virginia south into the western panhandle of Florida, inferentially southward into the peninsular part of that State. This is a distributional pattern characteristic of a great many species of plants and animals, possibly developing as a consequence of (1) recession of the shore line during the Tertiary, and (2) the simultaneous dissection of the old Cretaceous peneplain of eastern North America with the destruction of lotic habitats in the interior. So far as collection data go, it appears that *osceola* is largely confined to various species of *Procambarus*, but its range is less extensive than that even of *P. blandingii* in eastern United States. Specimens have been examined from the following localities:

VIRGINIA: CHARLES CITY COUNTY: Roadside ditch about 1 mile south of Providence Forge on Va. Hy. 155, June 2, 1949, P. C. Holt and M. L. Bobb (PCH 226). ISLE OF WIGHT COUNTY: Roadside ditch 2.8 miles east of Franklin on U.S. Hy. 58, May 31, 1949, Holt and Bobb (PCH 220). NANSEMOND COUNTY: Along U.S. Hy. 58, just west of Suffolk, May 31, 1949, Holt and Bobb (PCH 221).

SOUTHAMPTON COUNTY: Nottoway Swamp, 3.8 miles east of Courtland on U.S. Hy. 58, May 31, 1948, Holt and Bobb (PCH 219).

NORTH CAROLINA: WILSON COUNTY: Saratoga, April 18, 1956, Horton H. Hobbs (PCH 733).

SOUTH CAROLINA: BARNWELL COUNTY: April 20, 1956, Hobbs (PCH 710). CALHOUN COUNTY: 2.9 miles north of the Orangeburg County line, April 20, 1956, Hobbs (PCH 708).

GEORGIA: DECATUR COUNTY: Tributary to Mosquito Creek, just north of Chattahoochee, Florida, on Ga. Hy. 97, September 9, 1955, Hobbs and Hart (PCH 662). SEMINOLE COUNTY: 3.1 miles north of Iron City, September 9, 1955, Hobbs and Hart (PCH 661).

FLORIDA: LEVY COUNTY: Southwest of Otter Creek, April 1948, Hobbs (PCH 163). CALHOUN COUNTY: 7.7 miles south of Altha, September 3, 1955, Hobbs and Hart (PCH 664).

In addition, the published records of Goodnight (1941) for Florida and Georgia, under the name *vitrea*, probably apply to this form, and may be provisionally accepted. These records extend the range somewhat farther south onto the Florida peninsula.

REMARKS.—This species is named for the Seminole Chief Osceola, a heroic leader of the resistance of his people during their conflict with the United States Government.

INGENS GROUP

The mountains of the southern Appalachian system are inhabited by a very large and distinctive *Cambarincola* which fully warrants segregation into a distinct group.

Cambarincola ingens seems specialized in the characters of size and very long prostate, but nonetheless shows primitive features in the prominent deferent lobes of the spermiducal gland and the relatively slightly differentiated cuboidal epithelium of the prostate. I would suspect that it, or its progenitor, separated from the main line of evolution in the Philadelphica section at a fairly early stage.

Cambarincola ingens, new species

FIGURES 3, 4, 33, 34

Cambarincola philadelphica (not Leidy, 1851) Ellis, 1919, Proc. U.S. Nat. Mus., vol. 55, p. 260 (in part, West Virginia records only).—Goodnight, 1943, Journ. Parasitology, vol. 29, p. 100 (in part, Virginia record only).

TYPE SPECIMENS.—Holotype, USNM 29944, from *Cambarus sciotensis* collected in Sinking Creek about 1 mile west of Newport, Giles County, Virginia, by Ben I. Johns, June 27, 1953. Topoparatypes from the same collection (PCH 499) and the following, both from the type locality: July 1947, Horton H. Hobbs and others (PCH 234), and July 3, 1950, Holt, Tuten, and Kizer (PCH 407).

DIAGNOSIS.—A very large species of *Cambarincola*, adults to 12 mm. long in life and up to 6 mm. after preservation; in which the prostate is much longer than the spermiducal gland, beyond the end of which it is slightly sinuous or even loosely coiled, with a prominent clear terminal bulb. Spermiducal gland with a distinct posterior deferent lobe. Jaws heteromorphic but about equal in size, the dorsal dental formula 3 or 5, the ventral 4.

DESCRIPTION.—A large robust worm with a rather large head, body fairly slender with gradually increasing diameter to segment VII; segments about twice as broad as long; prosomites not greater in diameter than the metasomites.

Head broad, of considerably greater diameter than segment I, its length about one-sixth the total length of the animal. Peristomium not distinctly set off by a basal constriction, somewhat produced forward, with four distinct lobations on the dorsal half and two broader ventral lobes.

Jaws massive, similar in both size and shape in lateral aspect, anisomorphic, the dental formula 1–2 or 3–4, often 5–4 in young specimens. Median tooth of dorsal jaw not appreciably larger than paramedian teeth of lower jaw.

Male reproductive system moderate in size. Bursa ovoid to subcordate in lateral aspect, equally divided internally between atrium and penial sheath; penis small, conical, not extending down into atrium when in repose. Ejaculatory duct of moderate length, enlarged near the middle where about one-third the bursa diameter, extending dorsad up to about the middle of the segment. Spermiducal gland cylindrical, slender, its diameter usually less then half that of the bursa, extending cephaloventrad below level of ental end of bursa, at which point a small but distinct posterior deferent lobe occurs, overhanging the region of the penial sheath. Prostate gland elongate, slender, its diameter consistently about two-thirds that of the spermiducal gland, which however it greatly exceeds in length, the portion which extends beyond the anterior deferent duct being reflexed upon itself and uniformly sinuous and spiraled in form, with a distinct clear terminal bulb. Histologically the prostate differs from the adjacent gland, but the cuboidal cells are proportionately not so large and well-formed as in species of the Philadelphica group.

Spermatheca extending dorsad about half-way up the segment, composed of a cylindrical, thick ectal duct and an ovoid enlarged ental bulb, these two regions about equal in length. No glandular ental process.

VARIATION.—Except in such ontogenetically changeable characters as body size and distinctness of the dentition, there appears to be no evident variation in this species as regards the major specific

characters. The male reproductive system agrees in both size and proportions among specimens from the northern and southern extremities of the known range. Sexually mature animals range in length (preserved) from 4.0 to 6.5 mm., indicating considerable continuation of growth following maturity.

AFFINITIES.—Insofar as genital characters are concerned, this species is obviously closest to members of the Philadelphica group. It shares part of its range with both *C. philadelphica* and *C. fallax*, resembling the former in jaw characters and the latter in the development of peristomial tentacles. Probably it is phylogenetically closest, among living species, to *C. philadelphica*, and a study of the isolating mechanisms operating where these two occur together would be a matter of some interest.

DISTRIBUTION.—The southern Appalachians, from western North Carolina to extreme southeastern West Virginia, in the Blue Ridge and Valley and Ridge physiographic provinces. Specimens have been examined from the following localities:

NORTH CAROLINA: ASHE COUNTY: Buffalo Creek near Jefferson, June 14, 1950, Horton H. Hobbs and C. W. Hart (PCH 343). MACON COUNTY: Small tributary to Leatherman Creek, about 8 miles northwest of Franklin, July 18, 1958, R. L. Hoffman (PCH 881). WATAUGA COUNTY: Winkler's Creek at Boone, June 21, 1948, Mike Wright (PCH 132); Valle Crucis, June 14, 1950, Hobbs and Hart (PCH 350).

TENNESSEE: CARTER COUNTY: Catbird Creek, Shenandoah Heights Park, Johnson City, January 3, 1954, Holt (PCH 579). JOHNSON COUNTY: Tenn. Hy. 91, 10.7 miles southwest of Damascus, May 27, 1951, Holt (PCH 589). UNICOI COUNTY: Sam's Creek, 3 miles south of Flagpond, July 7, 1951, Holt (PCH 452); Jones Branch, July 2, 1955, Holt (PCH 583).

VIRGINIA: CARROLL COUNTY: U.S. Hy. 221, 3.1 miles south of Woodlawn, June 13, 1950, Hobbs and Hart (PCH 328). FLOYD COUNTY: U.S. Hy. 221, 7.9 miles south of Floyd, June 13, 1950, Hobbs and Hart (PCH 325); Hy. 221, south of Willis, June 13, 1950, Hobbs and Hart (PCH 326). GILES COUNTY: Sinking Creek, 1 mile west of Newport, July 1947, Hobbs and others (PCH 234), July 3, 1950, Holt, Tuten, Kizer (PCH 407), June 27, 1953, B. L. Johns (PCH 499); Cascades of Little Stony Creek, July 1947, Hobbs (PCH 243), June 25, 1952 (PCH 492); Big Stony Creek, August 14, 1950, W. R. Whitehurst (PCH 411). GRAYSON COUNTY: Comer's Rock Recreation Area, July 16, 1949, Holt (PCH 257); pasture stream northeast of Buck Mountain, July 17, 1949, Holt (PCH 259); stream northeast of High Rock on Buck Mountain, July 17, 1949, Holt (PCH 261); tributary to Big Wilson Creek about 4 miles south of Mouth of Wilson on Va. Hy. 16, June 14, 1950, Hobbs and Hart (PCH 339). PATRICK COUNTY: Rock Castle Creek, west of Woolwine on Va. Hy. 8, July 5, 1947, Hobbs and Wilson (PCH 290). WASHINGTON COUNTY: Tributary to Middle Fork of Holston River, 10.6 miles northeast of Abingdon on U.S. Hy. 11, April 14, 1951, Hobbs and West (PCH 436). WYTHE COUNTY: Wytheville, no date given, M. M. McDonald (USNM 17698); Reed Creek, 3.3 miles southwest of Wytheville on U.S. Hy. 11, April 14, 1951, Hobbs and West (PCH 439).

WEST VIRGINIA: GREENBRIER COUNTY: Dry Creek near White Sulphur Springs, July 3, 1947, Hobbs (PCH 294). MERCER COUNTY: East River, 5.3 miles south-

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west of Glen Lyn on U.S. Hy. 460, July 13, 1947, Hobbs and Wilson (PCH 109). SUMMERS COUNTY: Berger's Spring at Hinton, no date or collector given (USNM 17868). MONROE COUNTY: Indian Creek, August 6, 1900, U.S. Fish Commission (USNM 17691). County not determined: "Crane Creek," August 8, 1900, USFC (USNM 17687).

The range of this striking branchiobdellid does not correspond closely with that of any crayfish known to me, but is remarkably similar to that of *Desmognathus quadramaculatus*, a large plethodontid salamander with apparently similar ecological requirements. In Virginia and West Virginia, *Cambarincola ingens* seems largely restricted to the upper Kanawha drainage system, although spilling over (doubtless through recent stream captures) into the headwaters of both the Roanoke and Tennessee rivers. Further south, known localities are insufficient to invoke generalities, but the record for Macon County in western North Carolina suggests that *ingens* will eventually be found widespread as far as the mountains of Georgia. These Carolinian worms appear to be identical in sexual characters with others from Virginia, a specific homogeneity which provides little information about geographic variability but does permit the inference that *ingens* is continuously distributed over its range with little or no opportunities for local populations to become differentiated.

REMARKS.—That such an imposing species, abundant over its fairly extensive distribution, would be overlooked for so long is due in part to the traditional appeal to external characters in the definition of species. Specimens of *ingens* have been reported by Ellis (1919) under the name *philadelphica*, and I suspect that the material reported as that species from Reed Creek, Wythe [misspelled "Wortle"] County, Virginia, by Goodnight (1943) is likewise referable to *ingens* which is common in that stream.

Although collected from several species of crayfish, *ingens* seems most commonly to be found on *Cambarus sciotensis* Rhoades, which is by far the largest member of its genus in the upper Kanawha River system. Neither the crayfish nor the branchiobdellid have yet been taken in the adjacent headwater streams of the James River system.

The name *ingens* (Lat., huge) is given in consideration of the great size of this species, not approached by any other cambarincolid of eastern United States.

PHILADELPHICA GROUP

This is the trouble spot of the genus. To begin with, it contains the little-known and frequently misunderstood species *philadelphica* of Leidy, which is fairly widespread and variable in some respects. This variation, however, is not of the same nature as that which induced Ellis, and, following him, Goodnight, to make the species a

sort of catch-all. Actually the jaw structure and form of the sex organs is relatively stable, it is the individual and geographic variation in size, shape, peristomial lobation, and such characters which lend complications in the definition of specific limits. The heterogeneity of "philadelphica" in the sense of previous workers is here considerably abated by the extraction of a large element under the name *fallax*, a very distinctive and easily recognized form. Remaining are several stumbling blocks: The disposal of some rather distinctive subspecific populations now known to occur within the species, the relationship of *philadelphica* to *C. chirocephala*, and the status of *C. macrodonta* and *C. meyeri*. These matters are discussed more explicitly under the treatments of the respective entities.

The Philadelphica group is defined within the section by the relationship of prostate to spermiducal gland, viz, they are essentially subequal in length and collectively slightly curved and the prostate generally averages from one-half to two-thirds the diameter of the gland. There is no lobation (or but very little) of the gland at the entry of the deferent ducts. In general the group is definable on the basis of negative characters, including species not readily absorbed by the other three groups.

The male reproductive system remains remarkably similar in most of the species. There are a few deviants, such as the shortened prostate of *meyeri* and the reduced spermiducal gland of *chirocephala*, but in general such differences are only comparative. As a rule the jaws are dissimilar but equal in size except in *chirocephala*. An exception occurs in the new species *fallax*, which is homognathous with a 5–5 dental formula, and is placed in a separate subgroup. In most of the species the peristomium is divided into dorsal and ventral halves, with the dorsal produced into low but distinct blunt projections or even into elongate tentacles (again in *fallax*). Body form is variable, depending to some extent on the mode of preservation, but in a very general way the metasomites of *chirocephala* and *fallax* tend to be appreciably greater in diameter than the prosomites, imparting a strongly moniliform appearance to the outline of the body. The members of the group are here considered to be relatively closely related, separable largely by appeal to what I am inclined to consider characters of no great phylogenetic significance, yet fairly conspicuous and of the grade which has drawn the attention of most previous investigators.

Although the species themselves are not very difficult to define, their disposal into groups and subgroups has not been easy to accomplish, and the present arrangement represents only an arbitrary and subjective attempt. There seems to be little doubt that the male sex organs provide characters of the first order, but the necessity

has arisen of giving systematic supremacy to either peristomial configuration or jaw structure. As the latter is at least apparently fixed and invariable regardless of condition of the animal, I have made it the basis for recognition of a subgroup which contains two homognathous species, one with distinct peristomial tentacles, the other with a complete and entire peristomium.

A brief history of the described forms: The first member of this group to be named was called *Astacobdella philadelphica*, by Joseph Leidy in 1851. The description (the first validation of a name for an American branchiobdellid) was drawn largely from living specimens, and is fairly detailed. We can extract information on size, shape, peristomium, and jaw structure, and arrive at the impression of a worm which is essentially similar to recently acquired topotypical specimens from Philadelphica. In 1912, Max M. Ellis described specimens of a similar species from Colorado under the name *Cambarincola macrodonta*, making the separation largely on the basis of differences in the form of the peristomium—lobed or "crenulated" in *philadelphica* but entire in *macrodonta*.

Subsequently, in 1919, Ellis discussed variation in *philadelphica*, following the study of a considerable volume of material from his own collections in the midwest and those accumulated at the U.S. National Museum. Working with a much broader species concept than we now know to be justified, Ellis considered *philadelphica* to be a widespread, variable species, with the variation affecting both dental formula (in small details) and degree of lobation of the peristomium. Ellis believed that the normal lobes of the upper half of the peristomium could be extended or retracted at will by living animals, and that the size and shape of the lobes, varying from none to distinct tentacles, was likewise subject to the vagaries of preservation. Material identified as this species indicated a geographic range from New York to Wisconsin, and south to Kentucky and North Carolina (remarkably enough, almost identical with the present range of the species in its restricted sense).

In the same paper, Ellis described a species under the name *Cambarincola chirocephala*, based on specimens from Missouri in which peristomial lobes are present as in *philadelphica*, but the jaws unequal in size—the dorsal jaw from 1.5 to 2 times as wide as the ventral. In this paper, Ellis also published locality records for his species *macrodonta* from a number of widely scattered western states. Subsequent restudy of this material shows that Ellis has confused several species. Most of his specimens were either immature, overstained, or mounted flattened so that little more than the jaws could be seen.

No further attention was paid to this group of branchiobdellids until 1940, when there appeared the general monograph of the American species, by Clarence J. Goodnight. This paper is of interest to us at this point largely because of the remarkable treatment of the species of the Philadelphica group. In the case of *Cambarincola*, he recognized two subgenera, making the distinction by the following contrast:

> Upper lip composed of four subequal lobes. . . . *Coronata*, n. subg.
> Upper lip entire excepting a small median emargination.
> *Cambarincola*, n. subg.

According to Goodnight, the nominate subgenus consisted of the generotype species *macrodonta*, and *elevata* Goodnight, *vitrea* Ellis, and *inversa* Ellis. His new subgenus included the type *philadelphica* and *chirocephala* of Ellis: Curiously enough, this subgeneric dichotomy was proposed in defiance of a statement by Ellis which Goodnight then quoted under the treatment of *philadelphica:* "It was also found that worms of this species could flatten the entire lip, so that the lobes were scarcely visible." The virtue of Goodnight's groupings can be estimated by the fact that *macrodonta*, of one subgenus, can hardly be separated from the species of the other, while the nominate subgenus as originally proposed contained species which we now know to belong in three different genera. There is no defensible reason for continued recognition of the name *Coronata*, it is an absolute junior synonym of *Cambarincola* in the strictest sense.

Subsequent to 1940, one additional species has been named which is referable to the Philadelphica group. This is *Cambarincola meyeri* Goodnight, 1942, from central Kentucky.

The exact status of *C. okadai* Yamaguchi remains in great doubt. The species was described on the basis of worms taken from American crayfish introduced into Lake Chuzenji, near Nikko, Japan. The combination of tentaculated peristomium and homognathous, pentadont jaws strongly suggests that *okadai* is a senior synonym of the species here named *fallax*. The same combination, however, is found in the western *macrocephala*, and until more is known about the type material of *okadai*, or at least the origin of the crayfishes upon which it lived, we may continue to regard the species as *inquirendum*. Goodnight (1940, p. 41) dismissed *okadai* as probably based on specimens of *philadelphica*, ". . . as it differs from it only in the dentition of the lower jaw, and *C. philadelphica* is an extreme variable form as outlined above." The "above" referred to here is the quotation from Ellis's 1919 paper concerning variation in peristomial form only. Ellis did not consciously stretch variability in his *philadelphica* so far as to embrace two entirely different jaw shapes.

In the belief that *philadelphica* was both homognathous and heterognathous, tentaculate as well as not, Goodnight identified Virginia worms submitted to him in 1948 by P. C. Holt as typical of that species. On the basis of this information, Holt published in 1949 an account of the reproductive organs of the species, under the name *philadelphica*, although subsequent examination of his slides indicates that actually the material is mostly *fallax*. That a single species should encompass such variability, however, appeared unlikely to Holt, and he subsequently (1951) expressed some doubt about the correctness of Goodnight's determination in a discussion of worms from piedmont Virginia which had been named as *philadelphica*.

On the basis of a great number of specimens examined from numerous localities throughout the Appalachian region, I must conclude that jaw shape is a constant and reliable specific character, and is correlated with other structural specialties of a less conspicuous, but no less significant nature.

Two new species are herein added to the Philadelphica group, and there is every reason to assume that others will be disclosed by the future location of isolated endemic forms as well as by the analysis of more abundant material from eastern United States. The nominate species itself is almost certainly polytypic, as discussed in connection with the species. A number of variant forms in this general complex are omitted from present consideration, being known only from single specimens or poorly preserved material.

The following key to species should be approached like most keys—as an aid in identification rather than as the source of ultimate authority. Actually, this and other keys in the present paper are provided largely in order to give a tabular view of species grouped somewhat according to their presumed relationships. No key is as satisfactory as pictures when taxonomic characters are highly subjective ones!

Cambarincola meyeri is, with the utmost reluctance, entered as a member of both subgroups, owing to its poorly understood characters. See the discussion of this matter under the specific heading on page 355.

Key to Species of the Philadelphica Group

1. Homognathous species, the two jaws similar in size and shape, the median tooth always much larger than the laterals, dental formula 3–3 or 5–5 (FALLAX SUBGROUP) 2

   Heterognathous species, the jaws dissimilar in shape and often also in size; the dental formula 3–4, 5–4, 1–2, or a similar combination of odd (dorsal) and even (ventral) numbers of teeth (PHILADELPHICA SUBGROUP) . . . 4

2. Peristomium obviously tentaculate; prostate virtually as long as spermiducal gland (Appalachian Mountains and adjacent Piedmont areas from western New York to central Georgia) . . . . **Cambarincola fallax,** new species

   Peristomium entire or nearly so, no trace of lobes or tentacles 3

3. Prostate nearly as long as spermiducal gland; spermatheca long, slender, and not entally enlarged (western Virginia).

Cambarincola holostoma, new species

Prostate less than half as long as spermiducal gland; the latter unusually stout and strongly curved; spermatheca with a narrow ectal duct and large, subglobose ental bulb (Kentucky) . . **Cambarincola meyeri** Goodnight

4. Peristomium at least with four blunt lobes on its dorsal half; dorsal jaw generally at least somewhat longer and larger than the ventral 5

Peristomium at the most divided into dorsal and ventral halves, the dorsal without lobes; jaws essentially subequal in size at least in lateral aspect . 6

5. Head relatively larger (fig. 43), dorsal jaw distinctly broader than ventral (fig. 44); spermiducal gland comparatively small with respect to the prostate (central eastern Kentucky and Indiana west through the Ozark region into Kansas and Oklahoma, the diagnostic characters becoming accentuated westwardly) . . . . . **Cambarincola chirocephala** Ellis

Head relatively smaller (fig. 39), dorsal jaw only slightly broader than ventral (fig. 40); spermiducal gland relatively large in comparison with the prostate (North Carolina and Tennessee north to New York, west in the Great Lakes region to Wisconsin). **Cambarincola philadelphica** (Leidy)

6. Prostate gland at least half as long as spermiducal gland, usually subequal in length; latter elongated, slender, not recurved (fig. 38); spermatheca with a long ectal neck and a moderate ental bulb (western margin of the Great Plains in Colorado and adjacent states).

Cambarincola macrodonta Ellis

Prostate less than half as long as the stout, recurved spermiducal gland; spermatheca with a very short ectal duct and a large, globose ental bulb (Kentucky) . . . . . **Cambarincola meyeri** Goodnight

Cambarincola philadelphica (Leidy)

FIGURES 39–42, 51–54, 57

Astacobdella philadelphica Leidy, 1851, Proc. Acad. Nat. Sci. Philadelphia, 1851, p. 209.—Verrill, 1873, Rep. U.S. Fish. Comm. for 1872–1873, p. 688 (name only).

Branchiobdella philadelphica Moore, 1893, Proc. Acad. Nat. Sci. Philadelphia, vol. 45, p. 427.

Bdellodrilus philadelphicus Moore, 1895, Journ. Morphology, vol. 10, p. 497; 1901, Bull. Illinois State Lab. Nat. Hist., no. 5, p. 542.—Pierantoni, 1912, Ann. Mus. Zool. Univ. Napoli, new ser., vol. 3, no. 24, p. 17.

Cambarincola philadelphica Ellis, 1912, Proc. U.S. Nat. Mus., vol. 42, p. 484.—Hall, 1914, Proc. U.S. Nat. Mus., vol. 48, p. 190.—Ellis, 1918, Trans. American Microsc. Soc., vol. 37, p. 49; 1919, Proc. U.S. Nat. Mus., vol. 55, p. 260.—Goodnight, 1939, Journ. Parasitology, vol. 25, supp., p. 11 (abstract); 1940, Rep. Reelfoot Lake Biol. Station, vol. 4, p. 171 (New York records); 1940, Illinois Biol. Monogr., vol. 17, no. 3, p. 38 (records for N.C., Pa., W. Va., probably this species).—Holt, 1954, Virginia Journ. Sci., new ser., vol. 5, p. 169.—Holt and Hoffman, 1959, Journ. Tennessee Acad. Sci., vol. 34, p. 103.

Cambarincola philadelphia (sic) Yamaguchi, 1933, Proc. Imp. Acad. vol. 9, p. 191.

[The following references almost certainly pertain to other species]:

Cambarincola philadelphica Goodnight, 1941, Trans. American Microsc. Soc., vol. 60, p. 70 (Florida records); 1943, Journ. Parasitology, vol. 29, p. 100

(Virginia and Missouri records).—Rioja, 1943, Anal. Inst. Biol. (Mexico), vol. 14, p. 544 (Mexican records).

TYPE SPECIMENS.—Present whereabouts unknown. Originally from crayfish—probably *Cambarus bartonii*—collected by Joseph Leidy in streams in and around Philadelphia, Pennsylvania. Topotypes (PCH 695) from Wissahickon Creek in Philadelphia have been studied.

DIAGNOSIS.—A medium to large-sized, variable species of the Philadelphica group, characterized by the following combination of characters (only well-preserved specimens, in series, can be determined with certainty): Peristomium divided into dorsal and ventral halves, the dorsal larger and with four low marginal lobations; jaws relatively large and subrectangular in lateral aspect, the dorsal jaw usually a little larger than the ventral; male reproductive system moderate in size, filling from half to two-thirds of the coelom of one side of segment VI; bursa elongate, at least twice as long as broad, the penial sheath merging gradually into a fairly short ejaculatory duct; spermiducal gland slender and recurved ventrad, twice the diameter of prostate, latter long and slender, reaching to ental end of spermiducal gland.

DESCRIPTION (from "typical" northeastern specimens).—Body moderate to large in size, maximum length 5.0 mm. Proportions about normal for the genus, but anterior part of body less attenuated than in most species; segments IV to VIII of about equal diameter; prosomites about three times length of metasomites and of greater diameter, at least on anteriormost segments; caudal sucker small, its diameter less than that of segment I.

Head fairly large, as long as first three body segments, and its diameter equal to that of segment II; largest basally, narrowing slightly to base of peristomium which is set off by a distinct constriction and divided into two subequal halves. Dorsal half somewhat larger and longer than the ventral, and provided along its margin with four low rounded lobes (not visible in poorly preserved specimens, either macerated or shrunken), the ventral half with a median incision dividing it into two broad lobes. Peristomium not or but very slightly flared, generally continuing the head profile in lateral aspect.

Jaws massive, anisomorphic, heterodont, the dental formula 5-4 or 3-4, sometimes 3-2 in old specimens; dorsal jaw slightly larger than ventral, both, in lateral aspect, almost as high as long and thus subrectangular in appearance. Median tooth of dorsal jaw and paramedians of ventral larger than the lateral cusps but not to the extent seen in such species as *fallax*, *chirocephala*, and others.

Male reproductive system variable in size, usually occupying from one-half to two-thirds of the coelom of one side of the segment. Bursa typically elongate, at least twice as long as wide, most of the length being contributed by the atrium; penial sheath of normal

size and proportions and confined to the ental third of the bursa. Ejaculatory duct broadest ectally, merging gradually into penial sheath; entally it becomes narrower and is rather short in total length. Spermiducal gland long and slender, curving cephalad and then abruptly ventrad, extending down as far as level of penial sheath, frequently with a small fairly distinct posterior deferent lobe visible near the ental end. Prostate long and slender, half the diameter of the spermiducal gland or less, but extending ventrad to the level of the ental end of the latter, with a small but distinct terminal bulb.

Spermatheca without specific peculiarities, consisting of the slender, elongate ectal duct extending about one-third the way up one side, a fusiform ental bulb, and a distinct, fairly large glandular ental process.

VARIATION.—The allegedly great variability of what has been identified under the name *philadelphica* has become almost legendary. Ellis (1919) gave the idea its momentum in remarking that material from Douglas Lake, Michigan, occasionally has a dental formula higher than the usual 5–4 (presumably 7–4 or 7–6), and that the lobation of the peristomium was to some extent a function of their extension or contraction at the time of death. Now these remarks are perfectly in order, reflecting nothing more than one might expect in the line of individual and ontogenetic variation, but Ellis concluded by saying "*Cambarincola philadelphica* was the most variable species studied," and his words like those of many another pioneer were misused by his followers.

We now know that Ellis unfortunately mixed several species under his concept of *philadelphica*, including *mesochorea* and *fallax*. But his concluding statement was picked up by Goodnight and even used out of context to justify the relegation of *C. okadai* to the synonymy of *philadelphica*.

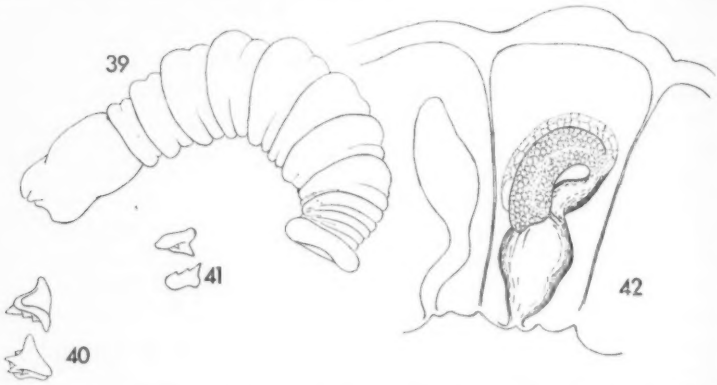
The foregoing preamble is not meant to deny variability within the limits of *philadelphica*, but to indicate that previous ideas on this score had little factual basis.

In the large amount of material available, I found that the species here identified as *philadelphica* is a rather plastic and complicated ensemble of microraces and incipient subspecies. Owing in part, at least, to differences in the way the crayfish hosts were preserved, there is a dismaying range in the size, shape, and proportions involved. However, in the most general terms, one can recognize fairly well-defined populations on the basis of body form, these to be mentioned in their turn. There is little appreciable difference in the reproductive systems, notably some variation in the overall size of the male organs which in some scattered localities tend to occupy more of the coelomic cavity than is typical for the species. Whether this reflects the

condition at maturity or some stage in the sexual activity, some sort of allometric growth, or merely sporadic local variation cannot be established at this time. The situation seems to be restricted to the southern Appalachian region.

There is considerable, apparently geographic, variation in size and shape of the jaws. The attention of future workers is particularly invited to investigation of this matter, something which I have been unable to do satisfactorily.

As diagnosed and briefly described in the preceding paragraphs, *philadelphica* ranges from central New York State west as far as



FIGURES 39–42.—Structural details of *Cambarincola philadelphica* (Leidy). 39, Lateral aspect of typical specimen; 40, jaws of the same specimen, dorsolateral aspect; 41, jaws of another specimen, lateral aspect; 42, reproductive systems, specimen from Frederick Co., Maryland.

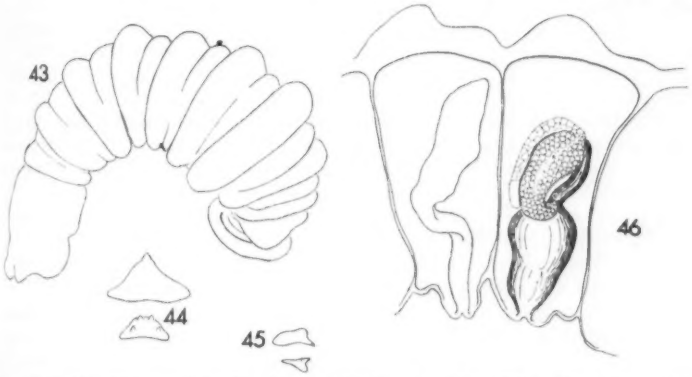
Minnesota, and south through the Appalachians and Piedmont to the Carolinas. An additional form appears to inhabit the Catskill region and adjacent areas, this is generally similar to the typical form but is apparently consistently smaller over a distinct geographic range. At several localities it occurs together with the large *philadelphica*. Whether it represents (1) a depauperate northern phase of the main population, (2) a distinct sibling species, or (3) merely an assemblage of young specimens, remains to be worked out by another investigator able to collect and make field studies in New York.

In central Kentucky and Tennessee occurs a form in which the peristomium, particularly the dorsal half, is hypertrophied and frequently widely flared, giving the head a campanulate appearance. This is probably a perfectly good subspecies, but the details of its overlap with *philadelphica* in eastern Kentucky ought to be worked

out prior to a formal recognition. The problem is complicated by the nearby occurrence of *chirocephala* which also appears to intergrade with *philadelphica*.

Representative specimens of each of the three forms of this species are illustrated, and material is separated appropriately in the lists of specimens examined. There is little or no appreciable difference in the reproductive systems.

AFFINITIES.—The species of the Philadelphica subgroup are all closely related and by no means easy to separate. A complication is introduced by the certainty that additional forms will be discovered and defined, particularly in the Appalachian region. Of the named



FIGURES 43–46.—Structural details of *Cambarincola chirocephala* Ellis. 43, Lateral aspect of typical specimen, Benton Co., Arkansas; 44, dorsal aspect of jaws, specimen from Benton Co., Arkansas; 45, lateral aspect of jaws, specimen from Logan Co., Arkansas; 46, lateral aspect of reproductive systems, specimen from Logan Co., Arkansas.

forms, *philadelphica*, *chirocephala*, and *macrodonta* are most alike, and future work may indeed show them to be only components of a wide-ranging polytypic species. Some of the Kentucky material listed under *chirocephala* shows a remarkable similarity in almost every respect to *philadelphica*, and I have been able to demonstrate gradual east-west clinal variation in both the jaws and spermiducal gland of *chirocephala*. That these two species intergrade seems almost certain. Perhaps the establishment of an arbitrary ratio of jaw widths will help define the ranges of the two, as well as their intermediates.

The relationships of *philadelphica* to *macrodonta* are also very close. The entire peristomium of the latter is a good distinction between well-preserved material of the two, and if present impressions are correct, the smaller bursa (less than the spermiducal gland in diameter) of *macrodonta* should aid in recognition of the species. *C. macrodonta* apparently occurs in South Dakota, *philadelphica* in Wisconsin.

Obviously the northern part of the Mississippi Valley is an area of some importance in establishing whether or not these two species overlap or intergrade.

DISTRIBUTION.—Northeastern United States, from New York west to Wisconsin, south through the Appalachian system as far as South Carolina and Tennessee. Material of the typical form of the species has been seen from the following collections:

MARYLAND: FREDERICK COUNTY: Catoctin Creek between Brunswick and Point of Rocks on Md. Hy. 464, October 12, 1952, L. B. Holthuis (PCH 600).

MINNESOTA: WRIGHT COUNTY: Clearwater River at Minn. Hy. 152, in the town of Clearwater, July 20, 1958, Holt (PCH 790).

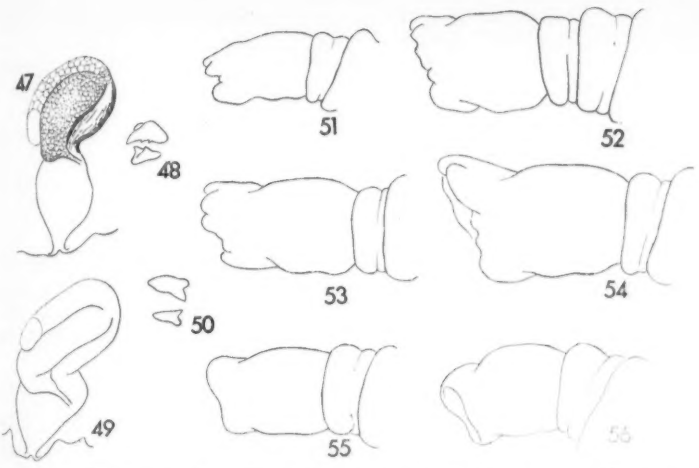
NORTH CAROLINA: WATAUGA COUNTY: Campus pond at Boone, June 24, 1948, Mike Wright (PCH 128).

NEW YORK: FRANKLIN COUNTY: Chateauguay River just west of Chateauguay on U.S. Hy. 11, May 21, 1951, D. W. Crocker and A. Gustafson (PCH 634). LEWIS COUNTY: Mohawk River at West Leyden, August 22, 1952, Crocker (PCH 552); outlet of Brantingham Lake, 3.5 miles north of Lyons Falls, May 21, 1951, Crocker and Gustafson, (PCH 639). TIOGA COUNTY: Catatonk Creek at Candor, August 29, 1952, Crocker (PCH 569). TOMPKINS COUNTY: Owasco Inlet, 3 miles south of Groton, May 18, 1951, E. C. Raney (PCH 628). WYOMING COUNTY: Cattaragus Creek at Arcada, August 29, 1952, Crocker (PCH 570).

PENNSYLVANIA: PHILADELPHIA COUNTY: Wissahickon Creek in Philadelphia, September 2, 1957, C. W. Hart (PCH 695).

SOUTH CAROLINA: YORK COUNTY: 4.0 miles south of Rock Hill on S.C. Hy. 72, April 20, 1958, Holt (PCH 748).

VIRGINIA: ALLEGHANY COUNTY: Dolly Ann Creek, 2 miles east of Covington on U.S. Hy. 60, June 18, 1948, G. Ailstock (PCH 115). AMHERST COUNTY: Pedlar River, 6.3 miles northwest of Forks of Buffalo on U.S. Hy. 60, November 11, 1947, Horton H. Hobbs (PCH 82). AUGUSTA COUNTY: 7.6 miles north of Steeles Tavern on U.S. Hy. 11, May 11, 1947, Hobbs (PCH 71). BEDFORD COUNTY: Little Otter River, 3.1 miles east of Bedford on U.S. Hy. 460, Holt and Bobb (PCH 73). BRUNSWICK COUNTY: 2.9 miles north of Edgerton on Va. Hy. 140, May 31, 1949, Holt and Bobb (PCH 217). BUCKINGHAM COUNTY: 9.6 miles south of Sprouse's Corners on U.S. Hy. 15, November 9, 1946, Hobbs and Hoffman (PCH 36). CAMPBELL COUNTY: Evington, July 13, 1947, Hobbs (PCH 106). CRAIG COUNTY: 1.5 miles south of Paint Bank on Va. Hy. 311, June 24, 1948, Hobbs (PCH 97). CHESTERFIELD COUNTY: Small stream below the lake in Camp Shawandasee, near Chesterfield Courthouse, May 14, 1949, Holt (PCH 211). FLUVANNA COUNTY: 1.5 miles south of Palmyra on U.S. Hy. 15, November 10, 1946, Hobbs and Hoffman (PCH 114). GRAYSON COUNTY: Stream in pasture north of High Rock, northwest of Independence, July 17, 1949, Holt (PCH 260). HANOVER COUNTY: 3.1 miles north of Ashland on U.S. Hy. 1, June 3, 1949, Holt and Bobb (PCH 230). HIGHLAND COUNTY: Shaw's Creek, 6.6 miles east of McDowell on U.S. Hy. 250, September 27, 1946, Hobbs (PCH 113). LOUISA COUNTY: 25.5 miles east of Charlottesville on U.S. Hy. 250, July 2, 1948, Holt and Bobb (PCH 121). MONTGOMERY COUNTY: Trillium Dale at Blacksburg, November 17, 1957, Holt, Riggin, Hoffman (PCH 873); Bottom Creek, 0.5 mile northeast of Otey on Va. Hy. 637, May 22, 1958, Holt and Hoffman (PCH 874). NELSON COUNTY: North Fork of Rockfish River, 5.4 miles south of Afton on Va. Hy. 151, September 1, 1946, Hobbs (PCH 112). ROCKBRIDGE COUNTY: Tributary to Buffalo Creek, 5.3 miles south of Lexington on U.S. Hy. 11, May 11, 1947, Hobbs (PCH 75); 4.3



FIGURES 47–56.—Structural details of three species of *Cambarincola*. 47–50, *C. chiro-cephala:* 47, Male reproductive system, Carroll Co., Arkansas; 48, jaws, caudolateral aspect, same specimen; 49, male reproductive system, Parke Co., Indiana; 50, jaws, lateral aspect, same specimen. 51–54, *C. philadelphica*, heads in lateral aspect: 51, Small northern form, Tompkins Co., New York; 52, typical form, Montgomery Co., Virginia; 53, amplistomate form, Jackson Co., Kentucky; 54, amplistomate form, Macon Co., North Carolina. 55, 56, *C. macrodonta:* paratypes, Boulder Co., Colorado, both specimens show the characteristic entire peristomium.

miles north of Glasgow on U.S. Hy. 501, May 11, 1947, Hobbs (PCH 78). ROCKINGHAM COUNTY: Swift Run, 3 miles east of Elkton, December 12, 1946, Holt (PCH 14). SCOTT COUNTY: Troublesome Creek, 8.2 miles west of Gate City on U.S. Hy. 58, June 16, 1950, Hobbs and Hart (PCH 366).

WEST VIRGINIA: East River, date and collector not stated (USNM 17705) [probably in Mercer County, southwest of Glen Lyn].

Specimens of the small New York phase (either a depauperate form of *philadelphica* or possibly a different species) have been examined from the following collections:

NEW YORK: CHENANGO COUNTY: Otego Creek, just east of Oneonta, August 27, 1952, Crocker (PCH 561). ONEIDA COUNTY: Tributary to the N.Y. State Barge Canal just west of Utica, August 23, 1952, Crocker (PCH 536); Oswego River at Rome, August 22, 1952, Crocker (PCH 583). TIOGA COUNTY: Catatonk Creek at Candor, September 6, 1959, L. R. McManus (PCH 928). TOMPKINS COUNTY: Owasco Inlet, 3 miles south of Groton, May 18, 1951, E. C. Raney (PCH 628). WARREN COUNTY: Stony Creek, in the town of Stony Creek, August 19, 1952, Crocker (PCH 546).

Material of the form with enlarged peristomium, discussed in the foregoing text, has been examined from the following localities:

KENTUCKY: JACKSON COUNTY: 1.8 miles south of Bond, July 29, 1958, Holt (PCH 831). WOLFE COUNTY: 1.7 miles west of Compton on Ky. Hy. 15, July 31,

1958, Holt, (PCH 846); large stream 5.1 miles east of Compton on Ky. Hy. 15, July 31, 1958, Holt (PCH 847).

NORTH CAROLINA: MACON COUNTY: Spillway of Lake Ravenel, Highlands, July 8–15, 1958, Hoffman (PCH 875); Buck Creek drainage 3.5 miles northwest of Highlands, August 3, 1958, Hoffman (PCH 884).

TENNESSEE: CUMBERLAND COUNTY: White Creek, 0.25 mile northwest of Alloway, May 3, 1959, Holt and Ford (PCH 903).

Cambarincola chirocephala Ellis

FIGURES 43–50, 57

Cambarincola chirocephala Ellis, 1919, Proc. U.S. Nat. Mus., vol. 55, p. 263, figs. 18, 19.—Goodnight, 1940, Illinois Biol. Monogr., vol. 17, no. 3, p. 37 (in part, Ill., Ind., Ky., Mo., ?Ala. records); 1940, Rep. Reelfoot Lake Biol. Station, vol. 4, p. 171 (?Tenn. record).—Holt and Hoffman, 1959, Journ. Tennessee Acad. Sci. vol. 34, p. 103.

TYPE SPECIMEN.—Holotype, USNM 17713, from *Orconectes virilis* collected at Rolla, Phelps County, Missouri, by J. Barley. This specimen is mounted flattened dorsoventrally, showing the jaws clearly; the reproductive systems are obscured.

DIAGNOSIS.—A small member of the Philadelphica group, recognized by the distinctly disparate anisomorphic jaws; by the reduced size of the spermiducal gland and prostate (both often shorter than the bursa); and by the elongate, slender, gradually enlarged spermatheca.

DESCRIPTION.—Body small, ranging from 1.5 to 2.5 mm. in length, the greatest diameter at segment VII; prosomites of all segments larger than metasomites. Diameter of segment I less than that of head; segments IX and X reduced, the caudal sucker abruptly enlarged, equaling or surpassing diameter of head.

Head of normal size and form for the genus, larger than segment I, as long as the first three body segments combined. Peristomium conspicuously set off by a basal constriction, flared, its margin provided with four small lobes on the dorsal side and two broad, lower lobes on the ventral.

Jaws disparate in both dorsal and lateral aspects, anisomorphic; broadly triangular. Dorsal jaw largest, 1.5 to 2 times as broad as the ventral, the median tooth very conspicuous, lateral cusps small or obscure. Ventral jaw subtrapezoid, with two small paramedian apical teeth and a median sinus, and a smaller sublateral cusp on each side halfway to the base.

Male reproductive system moderate in size, extending dorsal through about three-fourths of segment VI. Bursa elongate, pyriform, 2 or 3 times as long as its greatest diameter, the latter more than half the length of the ventral part of the segment. Atrial portion of bursa somewhat longer than the penial sheath. Ejaculatory duct long and slender, two-thirds to three-fourths as long as the

FIGURE 57.—Distribution of the three species of the Philadelphica subgroup. ○, *C. philadelphica;* ⊙, "amplistomate" variety of *philadelphica;* ◑, *C. macrodonta;* ●, *C. chirocephala.*

bursa, subequal in length to the prostate gland. Spermiducal gland relatively small, subequal to or shorter than length of bursa, its ental end recurved caudomesad prior to entry of the anterior deferent duct. Prostate relatively large, nearly as long and thick as spermiducal gland, the terminal bulb large and conspicuous.

Spermatheca long and slender, the ectal half curving laterad around the gut, ental half more or less abruptly enlarged to 1.5 to 2 times the diameter of ectal portion, the apex bluntly acuminate, not set off as an evident ental process. Total length of spermatheca somewhat greater than diameter of segment VII.

VARIATION.—Individual variation in this species is very slight, involving chiefly differences in size of the body. The proportions of the reproductive tracts remain constant for a given locality.

There is, however, some evidence that the sexual organs are subject to the influence of geographic factors affecting variation. There appears to be an east to west decrease in the spermiducal gland length as indicated by the illustrations (figs. 47, 49). In Indiana

and Kentucky material, this organ is fairly robust and somewhat longer than the bursa, while in specimens from Arkansas it is reduced in overall size and is shorter than the bursal length. The prostate remains unaffected over this range, so that in the southwest it becomes porportionately longer and broader with respect to the spermiducal gland. Presumably this variation is of at least potential systematic interest, but whether it is evenly clinal in nature, or broken at some intermediate area (such as the Mississippi River) cannot be ascertained on the basis of available material. Specimens from Illinois are presently not at hand for study, and for the time being the matter must rest at this point.

There appears to be a similar east to west cline in jaw structure, with the disparity in size becoming most distinct westward into Kansas and Oklahoma. Kentucky material tentatively referred to *chirocephala* can scarcely be distinguished from *philadelphica* on the basis of size of the jaws.

DISTRIBUTION.—*Cambarincola chirocephala* appears to be basically autochthonous to the Ozark highlands, now reaching its greatest abundance in northern Arkansas and Missouri. It extends, however, eastward into Indiana and Kentucky where its range meets that of *philadelphica*, with which it perhaps intergrades. Most of the Indiana localities are in the Wabash River system; one, interestingly enough, is in the Maumee River system which now drains northeast into Lake Erie. The presence of *chirocephala* in this drainage reflects either fairly recent stream piracy in the region or transgression of the low divides by crayfish—either possibility seeming equally likely. It will be a matter of interest to establish additional records for the species in northwestern Ohio and eastern Indiana. Goodnight (1940, p. 38) has reported this species from a number of midwestern localities as well as from some very unlikely stations in New York and Virginia, and such extralimital records must be presumed to have been based upon misidentifications.

MATERIAL EXAMINED: 22 slides, from the following localities:

ARKANSAS: BENTON COUNTY: Sugar Creek at crossing of U.S. Hy. 62, July 6, 1958, Holt (PCH 768). CARROLL COUNTY: South Fork of Dry Creek, 2.8 miles east of Green Forest on U.S. Hy. 62, July 6, 1958, Holt (PCH 766). CRITTENDEN COUNTY: 14.6 miles south of Marked Tree on U.S. Hy. 63, July 5, 1958, Holt (PCH 758). FULTON COUNTY: Salem, July 29, 1941, Horton H. Hobbs (PCH 310). LOGAN COUNTY: West fork of Mill Creek, 4.4 miles west of Delaware on Ark. Hy. 22, July 30, 1941, Hobbs (PCH 189). NEWTON COUNTY: Buffalo River, 14 miles south of Harrison on Ark. Hy. 7, July 29, 1941, Hobbs (PCH 175). SHARP COUNTY: 3.2 miles southeast of Hardy, July 29, 1941, Hobbs (PCH 176); about 9 miles west of Hardy, July 6, 1958, Holt (PCH 760). INDIANA: ALLEN COUNTY: St. Mary's River at Fort Wayne, Max M. Ellis (USNM 17706). MONROE COUNTY: Bloomington, May 1915, Will Scott (USNM

17709). PARKE COUNTY: 5.6 miles west of Bellmore on U.S. Hy. 36, July 26, 1958, Holt (PCH 807).

KANSAS: HARPER COUNTY: 10.7 miles west of the county line on Kans. Hy. 14, July 8, 1958, Holt (PCH 776).

KENTUCKY: CLARK COUNTY: 9.7 miles east of Winchester on Ky. Hy. 15, July 30, 1958, Holt (PCH 839). JACKSON COUNTY: 0.1 mile south of the Owsley County line on Ky. Hy. 30, July 29, 1958, Holt (PCH 834). MADISON COUNTY: Otter Creek, 9.3 miles north of Richmond on U.S. Hy. 227, July 30, 1958, Holt (PCH 841). OWSLEY COUNTY: Traveler's Rest, July 29, 1958, Holt (PCH 835). POWELL COUNTY: 1.4 miles east of Slade on Ky. Hys. 11 and 13; also Natural Bridge State Park, both July 29, 1958, Holt (PCH 836, 837).

MISSOURI: PHELPS COUNTY: Rolla, J. Barley (USNM 17713, the holotype). WASHINGTON COUNTY: Irondale, August 28, 1931, Robert Rice (PCH 168).

OKLAHOMA: COMANCHE COUNTY: Blue Beaver Creek in Fort Sill, June 6, 1959, J. W. Berry (PCH 905).

TENNESSEE: HUMPHREYS COUNTY: Hurricane Creek, 10.2 miles east of Waverly on U.S. Hy. 70, July 5, 1958, Holt (PCH 756).

REMARKS.—Goodnight (1940, p. 37) has emphasized the pronounced elevation of prosomites over metasomites as diagnostic of the species, and most specimens are so formed, but contracted individuals of many branchiobdellids likewise assume a distinctly annulated appearance. The larger size of the dorsal jaw is a good character for recognition of *chirocephala* over most of its range, but it must be recalled that in Kentucky this character loses must of its significance.

The affinities of *chirocephala* are discussed in connection with *C. philadelphica;* in brief, the likelihood of a genetic continuum between the two seems good. However, the actual details of this relationship are not clear at this time. Whether *chirocephala* represents the fairly recent modification of a westwardly migrating *philadelphica*-stock or whether it is an allopatrically differentiating species now radiating from its place of origin and intergrading with the original parent population remains to be established.

The name *chirocephala* (Gk. *chiros,* hand, and *cephalos,* head) presumably refers to the dorsal lobation of the peristomium, but it is not particularly appropriate since none of the material examined is more distinctly lobed than most specimens of even *C. philadelphica,* and in no way approximates the conspicuous tentaculation of *fallax* and some other species. Ellis himself misidentified the Indiana material cited as *philadelphica,* the records being originally published in the same paper as the description of *chirocephala!* The Indiana worms were merely mounted in such a way that the jaws could not be seen in dorsal aspect.

Cambarincola macrodonta Ellis

FIGURES 37, 38, 55, 56, 57

Cambarincola macrodonta Ellis, 1912, Proc. U.S. Nat. Mus., vol. 42, p. 481, figs. 1–3; 1919, Proc. U.S. Nat. Mus., vol. 55, p. 257 (Colorado records only?).—

Hall, 1914, Proc. U.S. Nat. Mus., vol. 48, p. 190.—Goodnight, 1940, Illinois Biol. Monogr., vol. 17, no. 3, p. 31 (description only); 1940, Rep. Reelfoot Lake Biol. Station, vol. 4, p. 171 (?South Dakota record).—Holt and Hoffman, 1959, Journ. Tennessee Acad. Sci., vol. 34, p. 97, figs. 1–6 (redescription of species).

TYPE SPECIMENS.—Holotype and two paratypes, USNM 53794, from *Cambarus diogenes* collected at Boulder, Boulder County, Colorado, by Max M. Ellis.

DIAGNOSIS.—A moderately small member of the genus, differing from other members of the Philadelphica group by the combination of the slender, elongate outline of both body and head, the large anisomorphic subequal jaws; entire peristomial margin; relatively large bursa in comparison with the long, slender spermiducal gland, and shortened prostate gland. The ectal spermathecal duct is much longer in relation to size of the ental bulb than in the other related species.

DESCRIPTION.—A distinctly slender and graceful worm, the body only slightly thicker at maximum diameter than at the narrowest part, tapering more distinctly caudally down to the small caudal sucker, its diameter less than that of either head or segment I. Segments less than twice as long as broad, the length almost equally divided into prosomite and metasomite, the former not at all larger in diameter than the latter.

Head rather long and narrow, about equal to first three segments combined, its greatest diameter a little greater than that of segment I. Peristomium set off by a basal constriction, not evidently flared, the margin divided into dorsal and ventral halves but neither half with lobes or tentacles.

Jaws large and massive, subtriangular in dorsal aspect, anisomorphic, heterodont, the dental formula 5–4; dorsal jaw slightly larger than ventral in lateral aspect, its median tooth subequal to the paramedian teeth of the ventral jaw.

Male reproductive system of moderate size, occupying half of one side of the coelom of segment VI or less, the bursa elongate pyriform, its greatest diameter near the ental third instead of near the midlength as in related forms; ejaculatory duct short, about equal to bursal diameter. Spermiducal gland slender and elongate, oriented almost horizontally in striking contrast to the oblique dorsoventral position taken by the gland in most other related species, increasing slightly in diameter entally, with the ental fourth of the length bent a little ventrad. Deferent lobes small or absent. Prostate about two-thirds as long as spermiducal gland and from one-fourth to one-half its diameter, extending along the dorsal side entally about as far as the entry of the posterior deferent duct.

Spermatheca composed of three parts: An elongate, slender, muscular walled ectal duct, which extends about halfway up the side of segment v; a subglobose or ovoid ental bulb; and a small terminal ental process composed of glandular cells.

VARIATION.—The material which was studied from three localities in Colorado is relatively homogeneous as regards structure of the jaws and reproductive systems, variations in these details being largely a reflection of difference in size of the worms. It is quite true that branchiobdellids are very variable in size after maturity, suggesting continuous growth through life, and actual measurements carry less significance than ratios of the measurements.

Various combinations of measurements as functions of some standard have been plotted graphically, and most of these show that the material of *macrodonta* examined maintains a very constant set of proportions despite changes in overall size. One suggestive detail involves relative head size. Three specimens from Fort Collins, Colorado, yield a head diameter to body diameter ratio of .60, .61, and .62. In eleven other specimens from Boulder and Black Wolf Creek, Colorado, the same ratio ranges from .71 to .99, with an average of .83. These values, plotted along the horizontal axis of a chart with body-length intervals on the vertical axis, separate out into two discrete groups. Unfortunately, it cannot be ascertained whether we are dealing here with true geographic variation or with the effects of preservation. Within a fairly wide latitude, the degree of contraction or distention of a branchiobdellid after preservation is influenced by the strength of the alcohol used. The foregoing example is introduced to remark the likelihood that with uniformly preserved worms in good series, a future student of the group will be able to cope with the problems inherent in the study of soft-bodied, muscular animals.

AFFINITIES.—*Cambarincola macrodonta* is without doubt closely related to *C. philadelphica*, and if the two occurred as sympatric or adjacent allopatric forms, it would be difficult to separate them with confidence. In well-preserved specimens, the peristomial character is most useful, but some individuals of *philadelphica* often do not show the peristomial lobes, and it is easy to understand how various other species have been misidentified by previous workers as *macrodonta*. On the basis of my own limited knowledge of the species, I would judge it to be an isolated, conservative remnant of the old late Tertiary pre-*philadelphica* stock which has become isolated in the foothills of the Rockies by recent climatic events which have produced the now semiarid nature of the Great Plains.

DISTRIBUTION.—This species has been recorded from 12 States ranging from New Mexico to Virginia, from South Dakota to Louisiana. The specimens which I have been able to re-examine, those identified

by Ellis in the U.S. National Museum collection, fall into three categories: Very small, obviously immature worms; adult but misidentified specimens; and, finally, a few slides of worms conspecific with the type specimen. The juveniles are at present unidentifiable with certainty. Misidentified adults include *C. mesochorea* and some other species which cannot be confidently identified but which are not *macrodonta* on jaw shape. Undoubted specimens of the species are listed as follows:

COLORADO: BOULDER COUNTY: Boulder, September 1915, Max M. Ellis (USNM 17667). LARIMER COUNTY: Fort Collins, L. C. Bragg (USNM 17662). YUMA COUNTY: Black Wolf Creek, near Beecher's Island, October 1915, B. Jaffa (USNM 17664).

In addition to these Colorado records, the specimen cited by Ellis from Las Vegas, New Mexico (USNM 17661), appears to be a *macrodonta*, but is so heavily stained that the sex organs cannot be seen. There is nothing from a geographic point of view to preclude the specimen being *macrodonta*.

Specimens from Muldon and Agricultural College, Mississippi, are very much like Colorado material in every respect, yet I hesitate to admit them to the list of *macrodonta* localities, at least until more material from Mississippi or from intermediate areas comes to hand.

Cambarincola meyeri Goodnight

FIGURES 67, 68

Cambarincola meyeri Goodnight, 1942, Trans. American Microsc. Soc., vol. 61, no. 3, p. 272, figs. 1–3.—Holt and Hoffman, 1959, Journ. Tennessee Acad. Sci., vol. 34, p. 103.

TYPE SPECIMEN.—Holotype, USNM 20597, from *Cambarus bartonii* collected in Raven's Creek, near Lexington, Fayette County, Kentucky, by Marvin C. Meyer (date unknown).

DIAGNOSIS.—A small to moderate-sized member of the Philadelphica group characterized particularly by the (?) entire peristomium, stout reniform spermiducal gland with a short slender prostate, and peculiar form of the spermatheca.

DESCRIPTION.—Length of holotype about 3.5 mm. Body of normal proportions, segmental diameter about three times the length at midbody; segments IV–VI of essentially the same size; prosomites elevated above level of metasomites; caudal sucker quite small, its diameter less than that of head or of segment I.

Head of moderate size, as long as first three body segments and slightly wider than segment I. Peristomium set off by a basal constriction, slightly flared but the margin entire except for being divided into a dorsal and ventral half; no evidence of lobes visible.

Jaws fairly small for size of head, heteromorphic, the dorsal jaw with a large median tooth and two very small cusps at its base on each side; ventral jaw with two large paramedian teeth and a single small cusp at the outer base of each. Jaws virtually identical in size, the dorsal very slightly wider at the base.

Male reproductive system characterized by the small globose bursa (its diameter less than that of the spermiducal gland), by the very slender, tubular prostate which is less than half as long as the spermiducal gland, and by the stout, acutely reniform shape of the latter, its ental half curved strongly caudad and accentuating the region of the posterior deferent duct.

Spermatheca composed of three major portions: 1, An enlarged, muscular ectal region about half as large as the bursa; 2, a strongly constricted cervical region of the ectal duct; and 3, a greatly expanded, thin-walled, subglobose ental bulb.

VARIATION.—The species is known only from two specimens. Goodnight's original description must have been based upon the paratype which he retained, for the holotype is somewhat larger than the published dimensions, its dorsal jaw 0.11 mm. in width instead of 0.07 as stated by Goodnight for his specimen. Having studied but the single specimen, I cannot say anything further on the subject of variation.

AFFINITIES.—*C. meyeri* is undoubtedly a member of the Philadelphica subgroup, but differs from the others at least in the slender, short prostate and strongly curved, heavy spermiducal gland. It is possible that Goodnight's observation on the peristomium will be confirmed, to constitute another diagnostic feature. Had no specimens been available for study, my inclination would have been to dismiss the name as probably a junior synonym of *philadelphica* or one of its localized races.

Goodnight states that "*Cambarincola meyeri* is closely related to *Cambarincola vitrea* Ellis, but differs in the structure of the upper jaw." I agree to a relationship between the two, but only as members of the same genus; actually they seem to be very dissimilar and fall into different groups of the Philadelphica section.

DISTRIBUTION.—Known definitely only from the type locality.

REMARKS.—The status of this species is by no means as well-established as might be desired. I have at hand a large series of well-preserved specimens from the vicinity of Livingston, Overton County, Tennessee (Holt, leg.), which agree in virtually every detail with the holotype of *meyeri*, not only in size and shape of the body, but also in small details of the reproductive systems. The concordance is such that conspecificity with the type specimen is almost assured. Yet there appears to be a discrepancy in the jaw struc-

ture—isomorphic and bipentadont in the Tennessee worms, anisomorphic and pentatetradont in *meyeri*. Two likelihoods can be considered: 1, The original types of *meyeri* may have been composite. Goodnight's account of the jaws was based on the paratype. Unfortunately, the dentition cannot be made out with certainty in the holotype, owing to its orientation on the slide; 2, the types of *meyeri* may be aberrant specimens with respect to jaw structure, if we assume that both are anisomorphic.

The question is one which can be settled only by the study of a series of fresh specimens from the type locality. On the basis of present knowledge of the group, it seems utterly unlikely that virtual identity in form of the sex organs would be contraverted by a basic difference in jaw structure.

For the present, however, I refrain from identifying the Tennessee worms as *meyeri*, remarking only their great similarity to the type of that species, and commending the matter to someone having the opportunity to secure topotypes of the species.

Cambarincola fallax, new species

FIGURES 58–60, 62, 63

Cambarincola philadelphica (in part) Ellis, 1919, Proc. U.S. Nat. Mus., vol. 55, p. 262.—Goodnight, 1940, Illinois Biol. Monogr., vol. 17, no. 3, p. 38.—Holt, 1949, Journ. Morphology, vol. 84, p. 535 et seq.

?*Cambarincola okadai* Yamaguchi, 1933, Proc. Imp. Acad., vol. 9, no. 4, p. 191; 1934, Journ. Fac. Sci. Hokkaido Imp. Univ., vol. 3, no. 3, p. 190.

TYPE SPECIMENS.—Holotype and four paratypes, USNM 29945, from *Cambarus longulus* subsp. collected in Maiden Spring Creek, about 1 mile east of Wardell, Tazewell County, Virginia, on June 19, 1959, by R. L. Hoffman. Additional paratypes from the same collection, PCH 904.

DIAGNOSIS.—A moderate to large species of the Philadelphica group characterized by the combination of homognathous, pentadont jaws and conspicuous elongate peristomial tentacles.

DESCRIPTION.—A moderate to fairly large species, up to about 4.0 mm. in length. Body form rather slender, without distinct enlargement in diameter in going caudad to the middle of the length. Prosomites about twice as long as metasomites and very distinctly larger in diameter, imparting a pronounced annulate body profile. Segments II to VII usually of about equal diameter.

Head moderate in size, about as long as first three body segments combined, its diameter about equal to that of segment II, equal to or slightly larger than diameter of caudal sucker. Peristomium large, set off by a deep basal constriction, almost half the total head length; the dorsal half often a little flared, with four distinct blunt

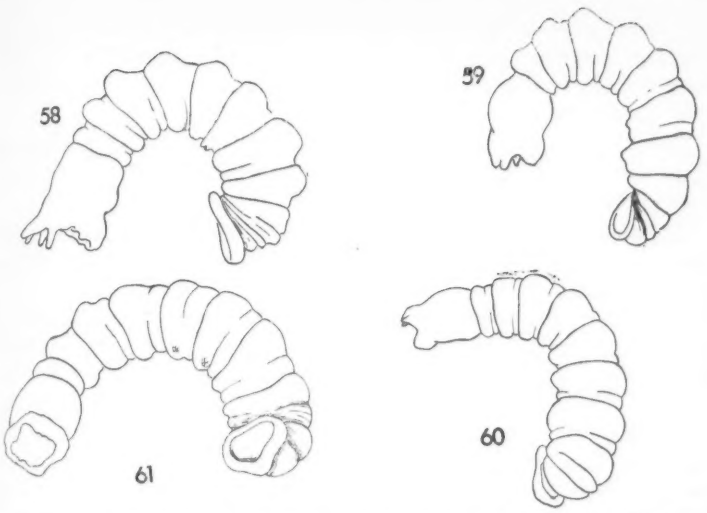


FIGURE 58–61.—Two species of the Fallax subgroup, external appearance. 58, *Cambarincola fallax*, new species, paratype from Tazewell Co., Virginia, with peristomium extended; 59, specimen from Seneca Lake, New York; 60, specimen from Pike Co., Georgia. 61, *C. holostoma*, new species, paratype from Highland Co., Virginia, showing the characteristic entire peristomium.

elongate tentacles of varying length. Ventral half of peristomium shorter, set off from dorsal by a deep lateral sinus each side, subdivided into two broad lobes.

Jaws about 10 percent of the head length, isomorphic, equal in size, heterodont; the median teeth distinctly larger than the lateral cusps which are nonetheless very distinct even in lateral aspect, dental formula 5–5, 5–3, or 3–3, the smaller figures occurring chiefly in old or large specimens.

Male reproductive system typical for the group, the more ectal organs of moderate size and occupying about two-thirds or less of the coelom on one side of segment VI. Bursa elongate pyriform, its greatest diameter at midlength; penial sheath abruptly merging into the much narrower ejaculatory duct; latter half as long as bursa. Spermiducal gland oriented almost dorsoventrally, extending down to or beyond level of penial sheath, generally subreniform in outline with an occasional enlargement homologous to the posterior deferent lobe of other species; diameter of gland about equal to that of bursa, but somewhat smaller in occasional specimens. Prostate gland long, slender, its diameter half that of spermiducal gland near their juncture; not extending entally as far as apex of the latter.

Spermatheca rather small, generally similar to that of *C. philadelphica*, composed of a slender ectal duct and an ovoid or fusiform ental bulb located about halfway up one side of segment v, no glandular ental process detected.

VARIATION.—Individual variation in body form and peristomial shape is shown in figures 58–60. The two most similar worms are from opposite extremes of the range.

The male reproductive system varies somewhat more than in most other members of this genus, particularly with respect to size of the spermiducal gland, but nothing has been noted to indicate any sort of geographic dispersion. Figure 62 shows the typical proportions of the larger organs. The spermatheca is likewise somewhat variable, particularly the appearance of the ental bulb. This, however, is pretty clearly a reflection of the degree of distention by its contents.

DISTRIBUTION.—Known from numerous localities throughout the Appalachian uplift and adjacent Piedmont from western New York south as far as central western Georgia. In the southern part of the range *fallax* appears to be the most abundant member of the genus, further north the records are more scattered and *C. philadelphica* becomes dominant. Material has been examined from the following localities:

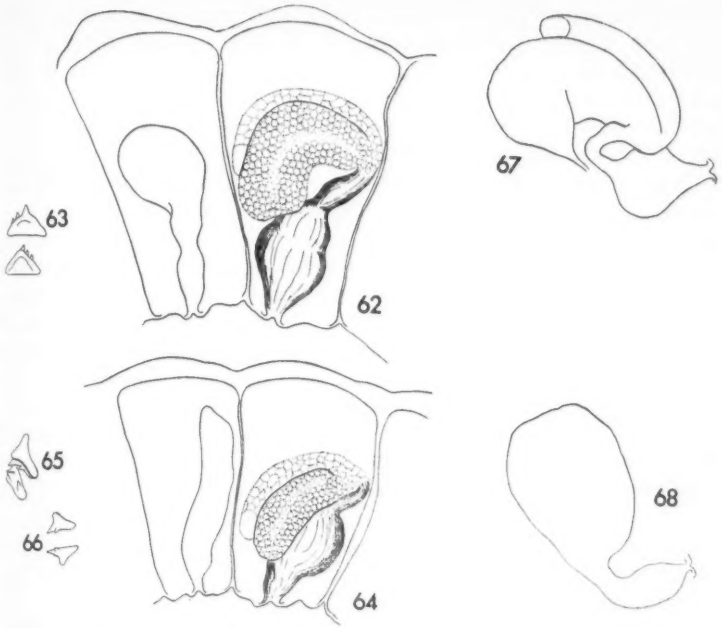
GEORGIA: FANNIN COUNTY: 5.7 miles south of Morganton on Ga. Hy. 60, November 6, 1958, K. Simonds (PCH 909). MURRAY COUNTY: Holly Creek, 10.6 miles north of the Gordon County line on U.S. Hy. 411, April 16, 1958, Holt (PCH 737). PIKE COUNTY: Large stream on outskirts of Zebulon, April 17, 1958, Holt (PCH 740). WHITE COUNTY: Small ravine, 1 mile south of Helen, July 11, 1958, Hoffman (PCH 877).

NORTH CAROLINA: CHEROKEE COUNTY: Beaver Creek, 0.5 mile northwest of Andrews, June 9, 1959, Simonds (PCH 912). CLAY COUNTY: 3 miles south of Tuni Gap on the Hayesville-Andrews road, June 5, 1959, Simonds (PCH 918).

TENNESSEE: MONROE COUNTY: Small woodland stream, 7 miles north of Madisonville on U.S. Hy. 411, April 16, 1958, Holt (PCH 738). POLK COUNTY: 2.3 miles south of Ocoee on U.S. Hy. 411, June 9, 1959, Simonds (PCH 907).

VIRGINIA: ALBEMARLE COUNTY: Tributary to Rivanna River near Stony Point, April 25, 1947, Holt and Hobbs (PCH 45, 46). BUCKINGHAM COUNTY: 9.6 miles south of Sprouses Corners on Va. Hy. 15, November 9, 1946, Hobbs and Hoffman (PCH 36). CHARLOTTE COUNTY: 8.8 miles south of Keysville on Va. Hy. 15, November 9, 1946, Hobbs and Hoffman (PCH 38). GILES COUNTY: Sinking Creek at Va. Hy. 700, near Newport, July 3, 1950, Holt, Tuten, and Kizer (PCH 407). PATRICK COUNTY: Shooting Creek, 1.6 miles south of the Franklin County line on Va. Hy. 40, April 13, 1953, Hobbs (PCH 723). TAZEWELL COUNTY: Maiden Spring Creek, about 1 mile east of Wardell, June 19, 1959, Hoffman (PCH 904, type series).

NEW YORK: TOMPKINS COUNTY: Owasco Inlet, 3 miles south of Groton, May 18, 1951, E. C. Raney (PCH 628). County not located: Reeder's Creek, 1949, L. C. Goldstein (PCH 245).



FIGURES 62–68.—Structural details of three species of *Cambarincola*. 62, *C. fallax*, new species, reproductive systems, specimen from Giles Co., Virginia; 63, dorsal aspect of jaws, same specimen, each jaw tilted slightly in opposite directions, dental formula actually 5–5. 64, *C. holostoma*, new species, reproductive systems, paratype from Highland Co., Virginia; 65, the same, jaws in dorsolateral aspect, same locality; 66, the same, jaws in lateral aspect, same locality. 67, *C. meyeri* Goodnight, male reproductive system, from holotype, Fayette Co., Kentucky; 68, the same, spermatheca from holotype, the specimen considerably flattened in mounting.

In addition to the foregoing records, there are doubtless many published localities for *C. philadelphica* which really apply to this species.

Cambarincola holostoma, new species

FIGURES 61, 64–66

TYPE SPECIMENS.—Holotype and four paratypes, USNM 29946, from *Cambarus bartonii* and *C. longulus* collected in Crab Run, 4 miles west of McDowell, Highland County, Virginia, on U.S. Hy. 250, by L. B. Holthuis, October 25, 1952. Topoparatypes, PCH 599.

DIAGNOSIS.—A member of the Fallax subgroup characterized by the long, slender body, the prosomites of which are not distinctly raised; by the completely entire, flared peristomium; and by the slender, elongate, fusiform spermatheca.

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DESCRIPTION.—A small worm reaching a maximum length of about 2.0 mm. in preserved specimens. Body form slender, the diameter increasing gradually to segment VI which is subequal in bulk to segments VII and VIII; caudal sucker somewhat larger than preceding segment and about as broad as the peristomium. Prosomites up to three times as long as the metasomites, but not of greater diameter.

Head about as long as the first three body segments combined, and equal in diameter to segment III, the peristomium set off by a very strong basal constriction and distinctly flared, its margin entire, without any trace of division into dorsal and ventral halves or into smaller lobes. Head otherwise not visibly segmented externally.

Jaws similar, dental formula 3–3 with the median tooth long and acute, the general appearance very similar to the jaws of *C. fallax* but the formula perhaps more often 3–3 than in that species.

Male reproductive system basically similar to that of other species of the Philadelphica group. Bursa rather long, equaling the length of the spermiducal gland, the two subequal in diameter. Ejaculatory duct modest in size, its length less than the diameter of the spermiducal gland. Latter of normal proportions, without evident lobation at entry of deferent ducts. Prostate long, slender, about half the diameter of spermiducal gland, which it joins slightly entally of the entry of the ejaculatory duct.

Spermatheca slender and elongate, curving laterad and dorsad around the gut, and becoming slightly wider but maintaining about the same diameter almost to its end at a point near the middorsal area of the segment, a distinct ental bulb not being well-developed.

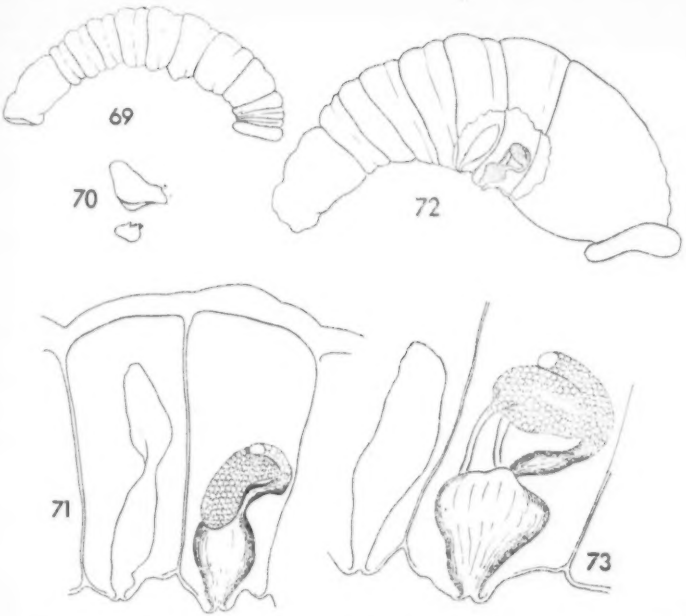
VARIATION.—In the small amount of material examined from three localities, some of it not well-preserved, there appeared to be little or no variation in the diagnostic characters of the species.

AFFINITIES.—The relationships of this form with *C. fallax* and *C. philadelphica*, with both of which it is sympatric, are unquestionable. It differs from both, however, in characters of the peristomium and spermatheca. Closer relationship with *fallax* is postulated on the basis of jaw form, here considered to be a more fundamental character than peristomial lobation.

DISTRIBUTION.—Aside from the type locality, this species is known from two collections from western Virginia, in the James and upper Potomac River drainages.

VIRGINIA: CRAIG COUNTY: 1.5 miles south of Paint Bank on Va. Hy. 311, June 24, 1948, Horton H. Hobbs (PCH 97). ROCKINGHAM COUNTY: Swift Run, 3 miles east of Elkton on U.S. Hy. 33, December 12, 1946, Holt (PCH 14).

REMARKS.—Further knowledge of the distribution of this localized form may be of interest in providing an insight into the factors influencing its speciation.



FIGURES 69–73.—Structural details of two species of *Cambarincola*. 69, *C. heterognatha*, new species, paratype in lateral aspect; 70, the same, lateral aspect of jaws; 71, the same, reproductive systems. 72, *C. demissa*, new species, body profile of paratype, Wise Co., Virginia. Part of body wall shown cut away to indicate the size of the reduced reproductive organs in situ; 73, the same, reproductive systems in lateral aspect, same specimen.

The collection localities, all of which I have seen, are rather small, swift, mountain brooks, somewhat different in character from the larger and perhaps more placid streams in which *fallax* occurs most abundantly. Conceivably the peristomium of *holostoma* represents the development of (or retention of) a more efficient holdfast device than the dissected and lobed mouth of *fallax*, a matter which would certainly enhance the origin and maintainence of specific differences by ecological factors.

The problem is recommended to someone having the opportunity to study branchiobdellids and their distribution in the upper James River system of western Virginia.

HETEROGNATHA GROUP

A separate group must be erected to represent on a coordinate standing the very unusual and highly specialized new species described

below. In many of its structural features, such as the disparate jaw size and shape, small body, reduced size of the male reproductive system, and particularly the shortened prostate gland, this species shows a combination of evolutionary specialities which occur only singly in various other forms of the genus.

Cambarincola heterognatha, new species

FIGURES 69–71, 74

TYPE SPECIMENS.—Holotype and paratype, USNM 29947, from *Cambarus* sp. collected in a tributary to Big Wilson Creek, 4 miles south of Mouth of Wilson on Va. Hy. 16, Grayson County, Virginia, by Horton H. Hobbs, Jr., and C. W. Hart, June 14, 1950. Additional paratypes indicated in the list of specimens examined.

DIAGNOSIS.—Immediately recognizable by the remarkably dissimilar jaws alone. In addition, the male reproductive system is reduced in size and the prostate gland is less than half the length of the spermiducal gland.

DESCRIPTION.—A moderate-sized species, body length up to about 3.0 mm., somewhat fusiform in body outline, the greatest diameter at segments VI and VII, the least at X.

Head of normal size and proportions, about as broad as long, its diameter less than that of segment I; peristomium only a little flared, without marginal lobes; head indistinctly subdivided into two halves by a slightly median constriction. Jaws very dissimilar in size, the upper triangular with a large median projection and about eight times the bulk of the lower (!) which is about equally quadrate in shape with two small paramedian cusps.

Body outline fusiform, segments VI and VII largest, each somite divided by a distinct complete constriction, the prosomites the larger of the two subsegments and not, or only slightly, elevated over the level of the metasomites.

Male reproductive system rather small, extending only halfway up the side of segment VI. Bursa fusiform, widest near the middle, about 1.5 times as long as broad, somewhat constricted at entry of ejaculatory duct. Latter of moderate length and rather slender, less than a third the bursa diameter. Spermiducal gland subreniform, slightly broader entally, its diameter equal to or slightly greater than that of bursa, the length a little greater. Prostate small and slender, less than half as long as spermiducal gland, generally about a third as long, the terminal bulb distinct.

Spermatheca elongate and slender, abruptly constricted at the midlength, the ental half with a rounded tip or a slight ental process, the organ extending dorsad nearly to the dorsal side of the coelomic cavity.

FIGURE 74.—Distribution of *Cambarincola heterognatha*, new species, an abundant Appalachian endemic species. Each spot represents collections for one county.

VARIATION.—There is little or no appreciable variation in this species as regards size of body, shape of jaws, and general details of the sex organs. There is some individual divergence in the relative length of the prostate gland, which may vary anywhere from a third to half the length of the spermiducal gland, irrespective of locality. The single collection from Kentucky is interesting in that the prostate of all specimens studied is basally much thicker than noted elsewhere in the range of the species, attaining a diameter at its base at least half that of the spermiducal gland. The Kentucky locality is considerably removed from the main distribution of the species, and this minor difference may reflect some significant microevolutionary development due to isolation. Aside from this one departure, *heterognatha* must be considered a very homogeneous species despite its considerable geographic range.

DISTRIBUTION.—The southern Appalachians, from northwestern Virginia and adjacent West Virginia, south and west to central eastern parts of Tennessee and Kentucky. Specimens have been examined from the following localities:

KENTUCKY: ADAIR COUNTY: 8.9 miles east of Columbia on Ky. Hy. 80, July 28, 1958, Holt (PCH 827).

TENNESSEE: CLAIBORNE COUNTY: 3 miles southwest of New Tazewell on Tenn. Hy. 33, April 16, 1951, Horton H. Hobbs and W. R. West (PCH 540). CUMBERLAND COUNTY: Daddy's Creek, between Crossville and Pikeville, August 1950, Holt (PCH 419). WASHINGTON COUNTY: Hartsell Cove, Buffalo Mountain,

August 1953, Holt (PCH 495); Sinking Creek in Horse Cove, January 10, 1954, Holt (PCH 580).

NORTH CAROLINA: WATAUGA COUNTY: 2 miles south of Vilas on N.C. Hy. 194, June 14, 1950, Hobbs and Hart (PCH 350).

VIRGINIA: AUGUSTA COUNTY: South River, 2.4 miles south of Waynesboro, September 3, 1948, Hobbs (PCH 271). CRAIG COUNTY: 1.4 miles west of Newcastle on Va. Hy. 311, June 23, 1948, Hobbs (PCH 99). FRANKLIN COUNTY: Smart View Picnic Area, Blue Ridge Parkway, September 14, 1958, Holt and Hoffman (PCH 891). GILES COUNTY: Cascades of Little Stony Creek, June 25, 1952, Holt (PCH 492, paratypes). GRAYSON COUNTY: Tributary to Big Wilson Creek, 4 miles south of Mouth of Wilson, June 14, 1950, Hobbs and Hart (PCH 339, types). LEE COUNTY: Hardy Creek, 11.1 miles west of Jonesville on U.S. Hy. 58, June 16, 1950, Hobbs and Hart (PCH 371). ROCKINGHAM COUNTY: Swift Run, 3 miles east of Elkton, December 1946, Holt (PCH 4). SMYTH COUNTY: White Top Mountain, September 5, 1951, John T. Wood (PCH 531). TAZEWELL COUNTY: Bluestone River, 11.2 miles northeast of Tazewell on U.S. Hy. 460, June 18, 1950, Hobbs and Hart (PCH 393, paratypes); Burkes Garden, June 30, 1947, R. L. Hoffman and H. I. Kleinpeter (PCH 532); Maiden Spring Creek, 1 mile east of Wardell, June 19, 1959, Hoffman (PCH 904). WASHINGTON COUNTY: 9.5 miles south of Abingdon on U.S. Hy. 11, April 14, 1951, Hobbs and West (PCH 432); 4.8 miles south of Abingdon, April 14, 1951, Hobbs and West (PCH 435); North Bristol, January 1, 1954, W. A. Whittaker (PCH 581). WYTHE COUNTY: Reed Creek, 3.3 miles southwest of Wytheville on U.S. Hy. 11, April 14, 1951, Hobbs and West (PCH 439).

WEST VIRGINIA: GREENBRIER COUNTY: Dry Creek, east side of Kates Mountain at White Sulphur Springs, July 3, 1947, Hobbs (PCH 294). PENDLETON COUNTY: 5.8 miles east of Franklin on U.S. Hy. 33, July 30, 1949, Hobbs and Word (PCH 275). WYOMING COUNTY: Barker Creek, 5.3 miles south of Tralee, July 12, 1947, Hobbs and Wilson (PCH 95).

From the standpoint of major drainage systems, the vast majority of the preceding records lie within the basins of the upper Tennessee and Kanawha rivers, and southwest Virginia clearly seems to be the center of abundance for this species. Peripherally, the records are distinctly more spotty, although in equally well-collected areas. Towards the northeast, the species occurs in the James and Potomac drainage systems.

The single known locality for Kentucky lies in a region which was intensively collected by Dr. Holt during July 1958, a fact which permits the inference that *heterognatha* may exist in central Kentucky only as a relict, and this fact, together with the generally sporadic distribution of species suggests that the range may be in the process of contraction, perhaps as a result of post-Pleistocene increase in temperature in the southern Appalachians.

Nonetheless, it must be emphasized that the distribution of *heterognatha* is by no means well-known, and many new localities doubtless remain to be established.

REMARKS.—It has already been observed that *heterognatha* is endowed with a remarkable combination of presumably evolutionary specializations. It is one of the easiest of branchiobdellids to recog-

nize, owing to the enormous dorsal jaw which dominates the entire anterior half of the head. In no other known form in the family is heterognathy carried to such an extreme.

Additionally, the spermatheca offers very good specific characters, particularly its length and pronounced median constriction which are evident in every specimen examined.

Presumably *heterognatha* is a highly modified member of the general *philadelphica-chirocephala* stock, which began to evolve its characters at a very remote time, or has been able to develop them more rapidly than other species of the genus.

DEMISSA SECTION

A separate section seems necessary to reflect the status of *Cambarincola demissa*, a very disjunct species which has little relationship with other members of the genus.

Judged from body shape, small head and jaws, and general appearance, this species is perhaps one modified as a gill-inhabiting form, and therefore especially liable to various structural concomittances of a specialized habitat. Unfortunately, we know nothing definite about the preferred microhabitat of the species.

Perhaps the most unusual feature of this animal is the marked reduction in the size of the reproductive systems, indicated in outline in the habit sketch of an entire worm (fig. 72). All of the normal organs are present, with the fine structure characteristic of the genus, but both spermiducal and prostate glands are very small proportionately, and the latter—although histologically not differentiated—terminates in a small clear bulb. The penial sheath of the bursa is much smaller, in relation to the atrium, than in any other member of the genus.

DEMISSA GROUP

A monotypic group with the characters of the section. The only species is a moderately small, corpulent-looking worm, probably branchiophilus, known only from extreme southwestern Virginia.

Cambarincola demissa, new species

FIGURES 72, 73

TYPE SPECIMENS.—Holotype and four paratypes, USNM 29948, from *Orconectes erichsonianus* and *O. juvenilis* collected in a tributary to the Powell River at Big Stone Gap, Wise County, Virginia, by Horton H. Hobbs, Jr., and C. W. Hart on June 17, 1950.

DIAGNOSIS.—A moderate-sized (2.8–3.2 mm. long) cuneate species of *Cambarincola*, differing from all other members of the genus in the exceptionally small sex organs, the prostate gland likewise differing

from all others in terminating in a small clear bulb although not histologically differentiated from the spermiducal gland.

DESCRIPTION.—Body strongly enlarged caudally, segments VI and VII about twice as wide as segment I, and tapering very abruptly to the fairly large caudal sucker which is as broad as the head or segment I. Segments very short, as little as a third of the body diameter at segment VI; prosomites twice as long as metasomites but not elevated above them.

Head as long as first three body segments, but smaller in diameter and thus continuing the anterior attenuation of the body; peristomium about a third of total head length, set off by a strong basal constriction, its margin apparently broadly lobed but not extended into projections or tentacles (all material slightly macerated). An additional more posterior constriction of the head occurs and imparts a trisegmented appearance to the head in lateral aspect.

Jaws relatively quite small, about 7.0 percent of the head length, the dorsal jaw slightly the larger and longer, with a distinct large projecting median tooth; ventral jaw likewise with a median tooth and subsimilar in general form to the dorsal, at least in lateral aspect (none of the available material is mounted in a way to show dorsal or ventral surfaces of the jaws, but careful observation indicates that the dental formula is probably 3–3 or perhaps even 1–1).

Male reproductive system very small, confined to the ventrolateral portion of the coelom of segment VI, extending dorsal less than halfway up one side of the segment. Bursa small, cordate, the atrial portion making up most of its bulk, the penial sheath confined to the ental fourth of the bursa and very small by comparison with that in other species. Ejaculatory duct moderately long, its length about equal to that of the bursa or spermiducal gland, its wall muscular but of normal thickness. Spermiducal gland and prostate collectively only about as large as the bursa, their histological structure similar (small, glandular, basophilic cells), but the prostate terminates in a small clear bulb presumably homologous to that so characteristic of the Philadelphica section. Spermiducal gland short and broad, at most only half again as long as the diameter; prostate slender but much shorter than spermiducal gland. Latter entally rounded, without evident lobation at the entries of the small, slender deferent ducts.

Spermathecae equally reduced, extending less than halfway up one side of segment V, the shape somewhat fusiform, expanding laterally from the small ectal portion and maintaining essentially the same size to the abruptly acuminate ental tip.

VARIATION.—Owing to the small amount of available material, all of which is slightly macerated from the initial preservation in weak alcohol, it is not possible to dwell at any length on the observed varia-

tion. Because of the small size of the sex organs, which are not particularly confined by the gut as in most other species, the spermiducal gland and prostate in particular are liable to considerable freedom of motion in the coelom, and preserved specimens show much variation in the shape of these two structures due to a difference in perspective. The spermatheca seems to have a constant shape, as does the general body outline. The range of this species may be so limited that geographically influenced variability will be found negligible.

RELATIONSHIPS.—There is no other species in the genus with which *demissa* can be compared. *C. branchiophila* of the Mesochorea section is known to be a gill form, and has small jaws and a cuneate body form, but its sex organs are of normal size and the major parts of the bursa correctly proportioned. It is difficult to derive *demissa* from either of the other two major sections of the genus, although if compelled to make a choice I should tentatively place it much closer to the Mesochorea section as representing the culmination of evolutionary tendencies in that ensemble. As this form is probably localized among the high mountains of southwest Virginia, there is every reason to presume that many other endemic species remain to be discovered, and some of these may cast some light on the affinities of this curious and disjunct little worm.

DISTRIBUTION.—Aside from the type locality, *C. demissa* is known only from the following locality:

VIRGINIA: TAZEWELL COUNTY: Bluestone River, 11.2 miles east of Tazewell on U.S. Hy. 460; June 18, 1950, Hobbs and Hart (PCH 393).

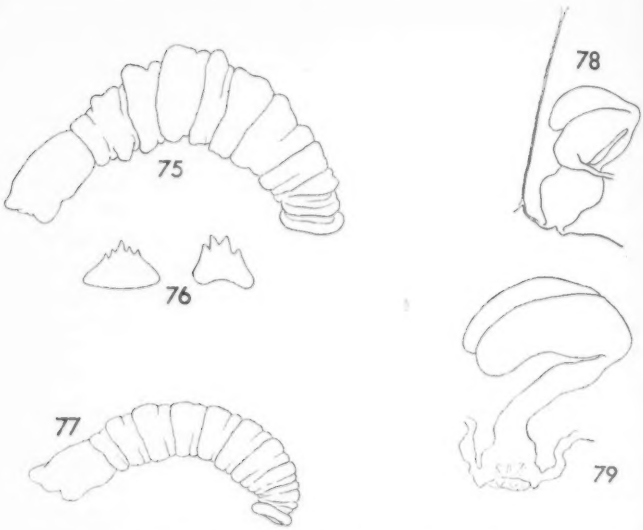
REMARKS.—The possibility of any host specificity on the part of this species is negated by the fact that the type series came from a collection of two species of *Orconectes*, the other known material from a collection of two species of *Cambarus*. Presumably the factors influencing the distribution of *demissa* are those of simple geography and water conditions rather than the occurrence of the crayfish hosts.

I cannot, at this time, imagine what might favor the selection resulting in the drastically reduced size of the reproductive systems, unless it be that residence within the branchial chambers of crayfish affords survival with a reduced number of progeny. Perhaps knowledge of the ecology of the species will shed some light on this interesting evolutionary problem.

The name *demissa* (Latin, humble, unimposing, modest) seems appropriate in view of the general form of the animal as well as its very moderately scaled reproductive systems.

Species of uncertain systematic position

Under this heading I include two species which are known to be referable to *Cambarincola*, but which, for one reason or another, cannot



FIGURES 75–79.—Structural details of two species of *Cambarincola*. 75, *C. floridana* Goodnight, body in lateral aspect, camera lucida drawing from holotype; 76, the same, jaws in dorsal aspect, from freehand sketch. 77, *C. gracilis* Robinson, body outline of holotype; 78, the same, male reproductive system of holotype; 79, the same male reproductive system, with bursa everted, paratype from British Columbia.

at present be allocated to a group or even to a section with assurance. The type specimens of both have been studied and drawn; the data on hand are summarized and presented at this time for the benefit of future workers who may be able to collect at the type localities and establish the identities of the names.

Cambarincola floridana Goodnight

FIGURES 75, 76

Cambarincola floridana Goodnight, 1941, Trans. American Microsc. Soc., vol. 60, p. 70.

TYPE SPECIMENS.—Holotype, USNM 20570, from *Procambarus fallax* collected in Taylor County, Florida, by Horton H. Hobbs. This specimen is mounted laterally, but the reproductive system cannot be made out with certainty.

REMARKS.—The bursa of this species is of considerably greater size, in relation to the other organs, than in most other species of the genus. Otherwise the general configuration suggests that *floridana* may be a specialized member of the Philadelphica section.

Cambarincola gracilis Robinson

FIGURES 77–79

Cambarincola gracilis Robinson, 1954, Journ. Parasitology, vol. 40, p. 466, figs. 1–4.—Holt and Hoffman, 1959, Journ. Tennessee Acad. Sci., vol. 34, p. 103.

TYPE SPECIMEN.—Holotype, USNM 26110, from *Pacifastacus klamathensis* collected at Whitman College, Walla Walla County, Washington, by A. G. Rempel. Paratypes: USNM 26111, from the Klamath River, Siskiyou County, California, and USNM 26112, Burnaby, British Columbia.

REMARKS.—This species was described and illustrated in some detail, the account being more meaningful than most of the existing descriptions. Not only the body form and jaws were drawn and discussed, but the form of the reproductive systems as well, and a reasonable comparison was made with *C. inversa* and *C. macrodonta*. It is unfortunate that equal care in the diagnosis of new species was not expended by several of Miss Robinson's predecessors.

I have examined the type material in the U.S. National Museum, and cannot improve upon the original description except to note that the bursa is of the typical cordate *Cambarincola*-form, and not a gradual enlargement of the ejaculatory duct as indicated in Robinson's figure 1. Her figure 3, a reconstruction from serial sections, was made from a worm with everted bursa.

The reduced size of the male sex organs is perhaps of some diagnostic importance, the appearance in situ being reminiscent of that of *C. demissa*. Miss Robinson failed to record the histological appearance of the spermiducal gland and prostate, and, unfortunately, I neglected to note the same detail when examining the type.

A re-examination of material of *gracilis* can readily establish the status and taxonomic position of the species. Assuming that the prostate is not differentiated (it is known to have no terminal bulb), the species will fall into the Mesochorea section and either the Branchiophila group or a new one of its own.

C. gracilis was recorded from ten localities in California, Oregon, Washington, and British Columbia, a relatively extensive range. Yet curiously enough, Goodnight (1959) refers *gracilis* to a category of so-called scarce, localized species in his most recent synopsis, while ranking in the main part of the key some of his own species known from but a single locality.

The paratype from California cannot be studied with respect to the reproductive system. That from British Columbia, however, is well-mounted, and appears to be correctly identified with the holotype. Drawings made from the holotype and paratype are presented as an aid for future recognition of the species.

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GEOGRAPHIC VARIATION IN THE THRUSH HYLOCICHLA USTULATA

By Gorman M. Bond

Introduction

Swainson's thrush, *Hylocichla ustulata*, known also in recent literature as the olive-backed thrush, is one of the most widely known of its genus. It has an extensive breeding range from Alaska across Canada to Labrador and Newfoundland. In the west it is found south through California and much of the Rocky Mountain area, and in the east it occurs as far south as the mountains of West Virginia. In its migrations it is found in wooded areas to the south of its breeding range throughout the United States, Mexico, and Central and South America to northern Argentina.

Four subspecies are listed in the American Ornithologists' Union Check List (1957, pp. 438–440): *H. u. ustulata* (Nuttall), the russet-backed form of the Pacific coast; *H. u. incana* Godfrey, recently named from Yukon; *H. u. clarescens* Burleigh and Peters, restricted by the authors to Newfoundland and Nova Scotia; and *H. u. swainsoni* (Tschudi), the olive-backed form of the trans-Canadian spruce belt. In the original descriptions and in most of the standard faunal works these races and others that have been proposed have been treated

individually with little attention to the overall picture of variation throughout the range. The present study is an attempt to evaluate the significance of color differences with particular emphasis on their value as racial characters.

Historical Summary

In early accounts of North American birds there is much confusion concerning the nomenclature of the five common smaller thrushes. Most of the names used for the present species had either a composite base or were preoccupied. Wilson (1812, pl. 43, fig. 2) illustrated the species but referred to it as a "hermit thrush," and in the accompanying text (p. 95) listed it as *Turdus solitarius*, a name antedated by *Turdus solitarius* Linnaeus of 1758 for another species. Nuttall (1840, pp. 400, 830) proposed *Turdus ustulatus* for the russet-backed population from Oregon, the first valid name for the species as a whole.

Swainson (Swainson and Richardson, 1832, p. 183) had earlier given an excellent description of an olive-backed thrush killed at Carlton House, Saskatchewan, in May 1827, but believing this bird to be the "tawny thrush" of Wilson, listed it as "*Merula Wilsonii* Bonaparte" from *T[urdus] Wilsonii* Bonaparte (1824, p. 34).

Cabanis (*in* von Tschudi, 1845, p. 28) perceived that Swainson had misidentified the bird from Carlton House and proposed the new name (in Mss.) *T[urdus] Swainsoni*. This is accepted as the subspecific name for the eastern population, and is the second valid name available.

Baird (1864, pp. 18–19) treated the eastern and western groups of Swainson's thrush as separate species under the two names *Turdus swainsonii* and *Turdus ustulatus* respectively.

In the same publication (p. 12) he erected the subgenus *Hylocichla* for the small North American thrushes.

Coues (1872, pp. 72–73) listed the "olive-backed thrush" in Baird's subgenus *Hylocichla* under the name *swainsoni* and included the gray-cheeked thrush (*Hylocichla minima*) as the variety "*aliciae*, Alice's thrush," in addition to *ustulatus*.

In further studies, Baird and Ridgway (Baird, Brewer, and Ridgway, 1874, p. 7) separated the gray-cheeked thrush as a distinct species and recognized *swainsoni* and *ustulatus* as varieties of a single species for which, however, they continued to use the younger name *T. swainsoni*.

The presently accepted trinomials *Hylocichla ustulata swainsoni* (Tschudi) and *H. u. ustulata* (Nuttall) came into official use with the publication of the third edition of the A.O.U. Check-List (1910).

Oberholser (1898, p. 304) gave his attention to the population from the southern Rocky Mountain area and concluded that they were

subspecifically distinct. To this race he gave the name *Hylocichla ustulata almae*. The following year, Oberholser (1899, p. 23) divided the russet-backed population of the Pacific coast into two forms. Birds from California and interior Oregon were given the name *Hylocichla ustulata oedica*, and the nominate form *H. u. ustulata* was restricted to birds of the northwest coast region.

The A.O.U. check-list committee (1899, pp. 127, 131) rejected the first of these names and accepted the second. This acceptance, however, was temporary; the committee (1908, p. 335) later rejected both names so that neither appeared in the third edition of the A.O.U. Check-List in 1910 nor in the fourth edition in 1931.

Further investigations of these thrushes led to temporary acceptance of *almae* as a valid name by the A.O.U. committee (1944, p. 457) but it was dropped again at a later date (1953, pp. 360–361).

In succeeding studies, Burleigh and Peters (1948, p. 118) separated the breeding birds of Newfoundland and Nova Scotia under the name *clarescens*, and Godfrey (1951, p. 173) described *Hylocichla ustulata incana* for the breeding population found from eastern Alaska and western Mackenzie south to northern British Columbia and northern Alberta. These two forms were added in the fifth edition of the A.O.U. Check-List (1957, pp. 439–440) to typical *ustulata* and *swainsoni* of the two previous editions.

Status of Proposed Names

In considering the dorsal coloration of Swainson's thrush across its entire breeding range in North America from Alaska to Newfoundland and southward in the Rocky and Appalachian Mountains, two distinct patterns are observable. The population from Alaska to the southern Rockies is definitely grayish above with several seasonal and sexual variations that approach the reddish olive of the eastern group. There is a weak color cline in which birds from the southern Rockies appear paler than birds from Yukon and Alaska, but I consider this tendency too slight to warrant nomenclatural recognition. Recently collected material from Idaho and eastern Washington are practically indistinguishable from birds collected during the last few years in northwestern Yukon. The type of *almae* from Nevada has been considered as a representative of *swainsoni*, but critical examination shows it to be a somewhat atypical specimen of the western population. At any rate, it is definitely a gray bird when compared with specimens from the eastern population. A specimen from Mountain City, Nev., is also definitely gray, as are specimens from southern Idaho and northwestern Utah. For this reason, the bird from Franklin Lake, Nev., described by Oberholser as *almae* will have to be considered the type of the grayish western population and the

subspecies described as *incana* by Godfrey will have to be considered a synonym of it.

From the Athabaska River eastward, the population exhibits a reddish-olive coloration dorsally, noticeably richer and warmer than in the Alaskan and Rocky Mountain group. I have not been able to separate specimens taken in the Atlantic maritime area (*H. u. clarescens* of Burleigh and Peters) from birds of the interior even on a conservative 75 percent basis (Rand and Traylor, 1950). For that reason I believe that *H. u. clarescens* Burleigh and Peters must be considered a synonym of *H. u. swainsoni* (Tschudi).

Topotypical material from the exact type locality of *swainsoni* is unavailable, but specimens from Cypress Hills, Fort Chipewyan, and the Athabaska River strongly indicate that the breeding population from Carlton House, Saskatchewan, is not the grayish race of the mountains and foothills to the west.

Birds from California and southern Oregon northward along the river bottoms, slopes, and ravines east of the Cascades to northern Washington are definitely paler and less rufescent than the russet-backed thrushes of the northwestern coastal forests; the name *H. u. oedica* Oberholser, therefore, should be used for this population. This usage will automatically restrict the nominate race *H. u. ustulata* (Nuttall) with type locality Fort Vancouver, Wash., to the area west of the Cascades in northwestern Oregon and thence northward along the coast to Juneau, Alaska.

Specimens from the Warner Mountains of California are unavailable to me, but earlier authors (Grinnell and Miller, 1944) referred to this section of the state as an area of intergradation between the California race of Swainson's thrush and a darker or grayer race. It seems reasonable to believe that the latter is *H. u. almae*.

This paper is based in the main on study of 442 specimens in the United States National Museum. Additional material was borrowed from other museums. The sources and numbers of these additional specimens and the abbreviations used in designating collections in the text are: Cornell University (CU), 3; National Museum of Canada (NMC), 37; Geological Survey Museum of Canada (GSMC), 12; Victoria Memorial Museum (VMM), 3; and the Ira N. Gabrielson collection (ING), 16. All specimens not otherwise designated are from the U.S. National Museum.

Prolonged study of the material showed that the only valid criterion for separating the several races in question is the color of the upperparts. Ventral coloration is mentioned in the literature as being of racial significance, but I have found that it is not reliable in delimiting the races. Wing, tarsal, and culmenal measurements taken of samples throughout the population showed no significant differences.

Magnification of × 10 in a binocular microscope was used in examining feathers for wear and abrasion.

For their many helpful comments and suggestions while the study was in progress I would like to express my appreciation to Dr. John W. Aldrich, Dr. Harry C. Oberholser, and Mr. Herbert G. Deignan. To Dr. Alexander Wetmore I am particularly indebted for the time and effort he has spent in helping me revise the final manuscript.

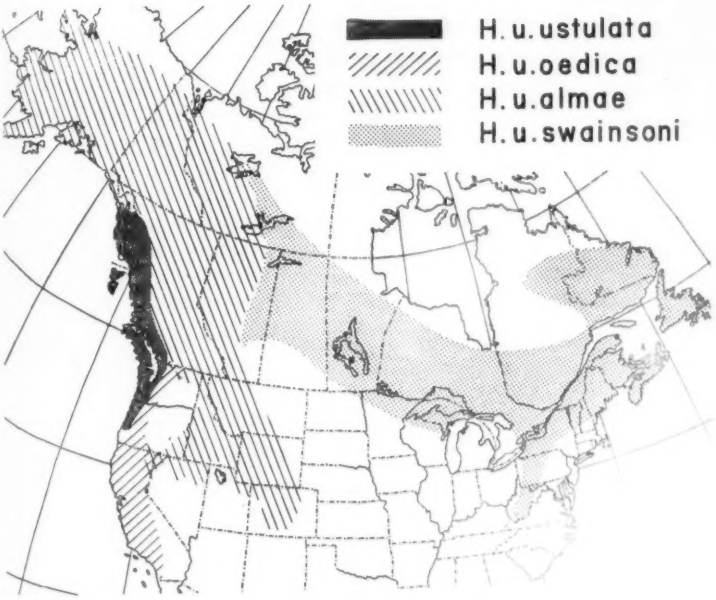

FIGURE 1.—Ranges of the subspecies of *Hylocichla ustu*

Dr. Herbert Friedmann allowed me to use specimens under his care in the U.S. National Museum collection.

The following persons loaned specimens: Dr. Ira N. Gabrielson; Dr. Kenneth C. Parkes, Cornell University; Dr. W. Earl Godfrey, National Museum of Canada, Geological Survey Museum of Canada, and the Victoria National Museum.

I also wish to express my appreciation to Dr. Brina Kessel, University of Alaska, and to Dr. Allan R. Phillips of Mexico City for their cooperation.

The Subspecies of *Hylocichla ustulata*

Hylocichla ustulata ustulata (Nuttall)

Turdus ustulatus Nuttall, Manual of ornithology of the United States and Canada, ed. 2, vol. 1, pp. vi, 400, 1840. (Forests of Oregon=Fort Vancouver, Wash.)

In breeding season the upperparts of the adult are a rather brownish umber, considerably brighter and richer than the same plumage of *oedica* and lacking the olive of *swainsoni*. They could under no circumstances be confused with the ashy gray upperparts of *almae*. The deep russet of fall and winter birds is the distinguishing characteristic of this race and sets it apart from the grayer, more subdued russet of *oedica*.

Breeding range is west of the cascades from northwestern Oregon to Juneau, Alaska. Winter range is mainly to western mainland of Mexico; one specimen is in the U.S. National Museum, from Tres Zapotes, Veracruz.

The following specimens were examined:

BREEDING: ALASKA: Sheep Creek, 1; Sitka, 3. BRITISH COLUMBIA: Howe Sound, 1; Port Moody, 2; Queen Charlotte Island, 3; Wellington, 2. WASHINGTON: Cathlamet, 1; Clallam County (Lake Sutherland), 1; Granville, 2; Neah Bay, 3; Vancouver, 1. OREGON: Multnomah County (Sauvies Island), 1 (ING); Portland, 1 (ING).

MIGRANT: WASHINGTON: Bumping Lake, 1; Carson, 1; Ellensburg, 1; Suez, 1. CALIFORNIA: Pacific Grove, 2; Placerita Canyon, 1; Stanford University, 1. MEXICO: Veracruz, (Tres Zapotes), 1.

Hylocichla ustulata oedica Oberholser

Hylocichla ustulata oedica Oberholser, Auk, vol. 16, no. 1, p. 23, January 1899. (Santa Barbara. Calif.)

Hylocichla ustulata ustulata (Nuttall) (part).

Adults in breeding plumage are similar to *ustulata* except that the upperparts are considerable paler and grayer. Compared with *swainsoni* they are more buffy, less olivaceous above. Fall and winter birds are slightly darker than those taken in the summer.

Breeding range is from California (except the southeastern part) and southwestern Oregon (Klamath Mountains), north along the east slopes of the Cascades to northern Washington. Winter range is in Baja California, Arizona, and southern Mexico.

The following specimens were examined:

BREEDING: WASHINGTON: Yakima, 1; Yakima County, (Big Klickitat), 1; Yakima County, (Ahtanum), 1; Mount St. Helens, 2; Wenatchee Lake, 1; Entiat, 1; White Salmon, 1. OREGON: Crater Lake, 1; Drew, 1. CALIFORNIA: Aptos, 1; Milpitas, 1; Nicasio, 1; San Diego County, 1; Santa Barbara, 1; Santa Cruz, 1.

MIGRANT: ARIZONA: Fort Huachuca, 1. MEXICO: Baja California (Salton River [thus on label]), 1; Chiapas (Chicharras), 1.

Hylocichla ustulata swainsoni (Tschudi)

T[urdus] Swainsoni Cabanis Mss. *in* von Tschudi, Untersuchungen über die Fauna Peruana, part VI, Ornithologie, pp. 187–188, 1845 [probably December]. New name for *Merula Wilsonii* Swainson, nec T[urdus] *Wilsonii* Bonaparte. (Carlton House, Saskatchewan River, Saskatchewan, lat. 53°).

Hylocichla ustulata clarescens Burleigh and Peters, Proc. Biol. Soc. Washington, vol. 61, p. 118, June 16, 1948. (Glenwood, Newfoundland).

Resembles *H. u. almae* Oberholser in the nuptial plumage except that the upperparts are decidedly more reddish, less grayish, olive; sides of head and breast are more buffy and spotting of breast paler. In autumn plumage it is separable by the deep reddish olive of its upperparts, distinctly different from the grayish to brownish olive of *almae* at the same season of the year. Compared with *ustulata* and *oedica*, *swainsoni* may always be separated by the olive suffusion of its upperparts, a characteristic that is lacking in the Pacific coast races, which are much more russet in coloration.

Breeding range is eastern Alberta (Athabaska River) eastward to Newfoundland and south in the mountains to West Virginia. Winter range, based on specimens examined, is Mexico (Veracruz, Tabasco, Tres Marias Islands); Central America (Costa Rica, Guatemala, Panama); South America (Colombia); West Indies (Bahamas). Recorded in migration in most of the States south of its breeding range. Occasional records in migration from west of the Rocky Mountains (Idaho, Washington, Oregon, British Columbia).

The following specimens were examined:

BREEDING: ALBERTA: Athabaska delta, 3; Athabaska River (East Branch), 1; Fort Chipewyan, 2. LABRADOR: Chateau Bay, head, 1; Eagle River, 1; Lake Melville (Etagaulet Bay), 3; Moisie Bay, 1 (NMC); Lac Marchant (Moisie Bay), 1 (NMC); Northwest River, 3. MAINE: Fort Kent, 6. MANITOBA: La Pas, 2 (NMC); Oxford House, 1; Seven Sisters, 1 (NMC); York Factory, 3. NEW BRUNSWICK: Grand Manan, 1. NEW YORK: Franklin County, 1 (CU). NEWFOUNDLAND: Badger, 2; Corner Brook, 1 (ING); Gander River, 15 mi. below Glenwood, 1 (ING); Glenwood, 2; Norris Point (Bonne Bay), 1; Bay of Islands (North Arm), 1; South Brook, 1; Stephensville, 1; Tomkins, 2; White Bear River (12 miles up), 2. NOVA SCOTIA: Cape Breton Island (Ingonish), 4; James River, 3. ONTARIO: Kapuskasing, 1 (GSMC); Lac Seul, 1 (GSMC). PENNSYLVANIA: Tamarack Swamp, 3. QUEBEC: Blue Sea Lake, 3 (ING); Mistassini Post, 1 (NMC); Notre Dame de la Dore, 1 (NMC); Pt. au Maurier, 1 (NMC); St. Felicienne, 5 (NMC). SASKATCHEWAN: Cypress Hills, 1 (NMC); Cypress Lake, 3 (GSMC). WISCONSIN: Outer Island, 3; Hebster, 1.

MIGRANTS: ALABAMA: Barachias, 1. ALBERTA: Athabaska Landing, 1; Athabaska River (30 mi. above landing), 1. BRITISH COLUMBIA: Moose Lake, 1; Okanogan Landing, 2. COLOMBIA: Bogotá, 1; Saóta, 1. COSTA RICA: Bonilla, 4; Coliblanco, 1; Hacienda Santa María, 1; Santa María de Dota, 1. DISTRICT OF COLUMBIA: 18. DELAWARE: Cedar Branch, 1. FLORIDA: Franklin County, 4. GEORGIA: Athens, 4; Atlanta, 1; Commerce, 1; Danielsville, 1; Decatur, 1; Grady County, 2; Young Harris, 1. GUATEMALA: Coban, 1. IDAHO: Moscow, 4; Potlatch, 3. ILLINOIS: Cook County (Glenwood), 4; Grand Crossing, 1. INDIANA:

Wheatland, 1; Vincennes, 1. KENTUCKY: Brandenburg, 1; Middleboro, 2; Uniontown, 1. MANITOBA: Duck Mountain, 1 (NMC); Shoal Lake, 1 (GSMC); Thicket Portage, 2 (NMC). MARYLAND: Finzel, 2; Kensington, 1; Laurel, 7; Montgomery County, 1; Ocean City, 1; Plummers Island, 2; Riggs Mill, 1. MEXICO: Chiapas (Comitan), 1; Tabasco (Teápa), 2; Tres Marias Islands, 2; Veracruz (Volcán San Martin), 1. MINNESOTA: Fort Snelling, 1. MISSISSIPPI: Cat Island, 1; Deer Island, 4: Gulfport, 9; Horn Island, 1; Saucier, 2. MONTANA: Little Missouri River, 1; Terry, 1. NEW YORK: Essex County (Lake Placid), 1; Ulster County (Slide Mountain), 1. NORTH CAROLINA: Asheville, 1; Bethel, 1; Clinton, 1; Mitchell, 1; Statesville, 1. NORTH DAKOTA: Fairmount, 1. OKLAHOMA: Tulsa, 3. ONTARIO: Lac Seul, 1 (GSMC); Norfolk County (Long Point), 1 (NMC); Ottawa, 1 (NMC). PANAMA: Chiriqui Province, 1. PENNSYLVANIA: Carlisle, 2. QUEBEC: Blue Sea Lake, 2 (ING); Hudson Heights, 1 (NMC); Lake Albanel, 1 (NMC). RHODE ISLAND: Johnston, 1. SASKATCHEWAN: Cypress Lake, 4 (GSMC). SOUTH CAROLINA: Bennettsville, 1; Chester, 1. SOUTH DAKOTA: Hill City, 1. TENNESSEE: Hornbeak, 2; Reelfoot Lake, 2; Roan Mountain, 2; Waynesboro, 1. TEXAS: Castle Mountain, 1; Tacosa, 1. VIRGINIA: Alexandria, 3; Alexandria County [thus on label], 1; Arlington, 1; Chesterfield County Court House, 1; Falls Church, 3; Four Mile Run, 1; Gainesville, 1; Giles County, 1; Lexington, 6; McLean, 2; Mount Vernon, 1; Richmond, 1; Shenandoah National Park, 1; Williamsburg, 1. WASHINGTON: Pullman, 1; Tunk Mountain, 1. WEST VIRGINIA: Enon, 1. WEST INDIES: Swan Island, 1. WISCONSIN: Alden, 1; Milton, 1; Outer Island, 2. WYOMING: Moran, 1; Teton Mountains, 1.

Hylocichla ustulata almae Oberholser

Hylocichla ustulata almae Oberholser, Auk, vol. 15, no. 4, p. 304, October 1898. (Humboldt Mountains, across from Franklin Lake, Nev.)

Hylocichla ustulata incana Godfrey, Canadian Field Nat. vol. 65, no. 5, p. 173, September-October 1951 [Feb. 21, 1952]. (Lapie River, Canol Road, mile 132, Yukon Territory.)

Hylocichla ustulata swainsoni (Tschudi) (part).

Adults in breeding season are distinctly grayer, less olivaceous above than *H. u. swainsoni* (Tschudi). Fall birds tend to be more grayish to brownish olive, less reddish olive than the eastern population. Sides of head and breast usually paler, and spotting of breast darker than *swainsoni*.

Breeding range is Alaska (except southeastern coast), Yukon, western Mackenzie, west-central Alberta, south through the mountains to Colorado and northwestern Utah. Few winter specimens are available, but fall and spring records indicate a heavy migration along the Mississippi Valley. The most abundant records during migration occur in the southeastern and Gulf States where some birds probably spend the winter (Saucier, Miss., Dec. 2, 1935). Only one wintering specimen has been identified from outside the United States: Costa Rica (Bonilla), April 13, 1908. Extremely rare in migration along the Atlantic coast.

The following specimens were examined:

BREEDING: ALASKA: Anchorage, 3 (ING); Bettles, 2; Circle, 7; Circle (20 miles above), 2; Eagle (mountains near), 1; Fairbanks, 2 (ING); Fort Egbert, 1; Katmai National Monument, Brooks Lake, 1 (ING); Kushkokwim River (North Fork), 1;

Robinson River, 2; Toklat River (head of), 1. ALBERTA: Grimshaw, 1 (NMC); Joussard, 7 (NMC); Slave River, 4 (intermediate). BRITISH COLUMBIA: Creston ,1; Hazleton, 1; Moose River (head of South Fork), 1; Summit Lake (12 miles north), 3 (NMC); Trail, 1 (VMM). COLORADO: Avolo, 2; Clear Creek, 1. IDAHO: Bovill, 1; Clearwater County (Headquarters), 2; Coeur d'Alene, 1; Harvard, 2; Idaho County (Whitebird Summit), 1; Inkom, 2; Latah County (East Fork Meadow Creek), 1; Latah County (Princeton), 1; Moscow Mountain, 1; Potlatch, 1; Priest River, 1; Shoshone County, Avery, 2; Shoshone County (Dismal Lake), 1; Shoshone County (Lookout Pass), 1. MACKENZIE: Fort Norman, 2; Fort Simpson, 1; Fort Providence, 1; Great Slave Lake, 1; Nahanni River (mouth of), 1. MONTANA: Crazy Mountains, 2; Flathead Lake, 1; Ward Peak, 1. NEVADA: Franklin Lake, 1; Mountain City, 1. OREGON: Disaster Peak, 1; Jordan Valley, 2. WASHINGTON: Anatone, 1; Ferry Lake, 4; Swan Lake, 6. WYOMING: Greybull, 1. YUKON: Haines Road (mile 130), 1 (NMC); Lake Laberge, 1; Lake Marsh, 2; Lapie River (Canol Road, mile 132), 5 (NMC); Old Crow, 5; Stoney Creek, 1 (NMC).

MIGRANTS: ALASKA: Savage River (McKinley Park), 1 (atypical). ALBERTA: Athabaska Landing, 1; Athabaska River (30 miles above landing), 1; Banff, 1; Red Deer River, 1 (GSMC). BRITISH COLUMBIA: Babine Mountains, 1; Nulka Lake, 1; Okanogan Landing, 1; Telegraph Creek, 1 (slightly intermediate towards *ustulata*). COSTA RICA: Bonilla, 1. GEORGIA: Athens, 2; Decatur, 1; Stone Mountain, 1. IDAHO: Bonneville County (Gray), 2; Hope, 1; Lewiston, 1; Moscow, 25; Potlatch, 2; Silver, 1; Washington County (Cambridge), 1. ILLINOIS: Cook County (Glenwood), 9; Iroquois County (Papineau), 1; Will County (Braidwood), 1. KENTUCKY: Middlesboro, 1; Uniontown, 1. LOUISIANA: New Orleans, 2. MANITOBA: Grand Rapids, 1. MISSISSIPPI: Bay St. Louis, 1; Cat Island, 1; Deer Island, 2; Gulfport, 2; Saucier, 1. MONTANA: Fort Logan, 1; Glendive, 1; Johnson Lake, 1; Madison River, 1; Terry, 1. NORTH CAROLINA: Asheville, 1. NORTH DAKOTA: McHenry (near Bantey), 1. TENNESSEE: Roan Mountain, 1. UTAH: Utah County (Scofield Reservation), 1. VIRGINIA: Mount Vernon, 1. WASHINGTON: Blue Mountains, 1; Pomeroy (16 mi. south), 1 (ING); Tunk Mountain, 1; Uniontown, 1. WYOMING: Fort Steele, 2. YUKON: Laird River and Alaska Highway, 1 (NMC); Tagish Road (mile 19), 1 (NMC).

Geographic Variation

Adult males in fresh plumage: *Hylocichla ustulata ustulata*: The upperparts are bright russet in color; they are similar in hue but darker in value than the Dresden Brown of Ridgway (1912). Examples of specimens with this plumage selected at random from the U.S. National Museum collection are 360036, 262522, and 262231. *H. u. oedica*: Has the upperparts somewhat darker than the Deep Olive of Ridgway. Examples are 262230 and 134188. *H. u. almae*: The upperparts are brownish olive above. This color is quite near the Olive of Ridgway. Examples selected at random from the main series are 298158, 341604, 420836, 465075, and 465333. *H. u. swainsoni*: Characterized by a much more reddish-olive overcast to the upperparts, nearest the Raw Umber of Ridgway. Examples are 342628, 458080, 466952, and 466953.

Subadult males in fresh plumage: *Hylocichla ustulata ustulata* and *H. u. oedica*: Similar to adults in fresh plumage. *H. u. almae*: Slightly

more reddish olive above than adult males. Nearest the Medal Bronze of Ridgway. Specimens of *almae* exemplifying this plumage are 193042, 419145, and 425279. *H. u. swainsoni*: Subadult males in fresh plumage are not too different from adult males; in series they appear to be somewhat less bright reddish olive above. Examples are 271375, 301600, 349253, 361680, 393349, and 458079.

Adult males in breeding plumage: *Hylocichla ustulata ustulata*: The upperparts are dull russet, similar to the Saccardo Umber of Ridgway. Specimens selected at random from this color series are 529 (ING), 286675, and 156359. *H. u. oedica*: Has the upperparts quite near the deep olive of Ridgway. Examples are 394934, 420624, and 262237. *H. u. almae*: The upperparts are dark ashy gray; Ridgway's Olive is nearest this hue. The following random samples are illustrative: 395459, 465332, 465976, 468145, 397341. The type specimen of *almae* belongs here. This specimen has caused considerable confusion in the past because it is slightly lighter in value than other, more "typical," specimens of the western population; however, the dorsal coloration is definitely Olive in hue if not in saturation. Another specimen, taken at Mountain City, Nev., a short distance from Mountain Lake, is definitely *almae*. *H. u. swainsoni*: More reddish olive above than *almae*, and its dorsal coloration falls between the Brownish Olive and light Buffy Olive of Ridgway. Samples of adult males in breeding plumage are 136319, 271370, 259580, 340549, 382036, 394307, and 4440 (ING).

Subadult males in breeding plumage: This plumage is retained by first-year birds until they have completed nesting activities. It is characterized by spotted-wing coverts. The feathers of first-year birds in breeding plumage are much more abraded than those of adults at the same season of the year because the first-year birds did not undergo a postnuptial moult during the previous fall. Two examples of *Hylocichla ustulata almae* in "typical" subadult breeding plumage are 367528 and 397342. Although they usually retain a slight reddish-olive wash above, subadult breeding specimens of *swainsoni* become so dark that they are sometimes difficult to separate from *almae*. This condition is probably responsible for the conclusion of several authors (Burleigh and Peters, 1948; Braund and McCullagh, 1940) that *incana* [=*almae*] extends all the way across northern Canada to the Atlantic coast. A warm yellowish wash at the base of the pileum is a characteristic of the eastern population and, when present, is an excellent diagnostic character in separating the two races of this particular age and plumage. Occasional birds occur in the plumage of subadults but lack the spotting of the wing coverts. The type of *clarescens* is an example of this sort. Two examples of *swainsoni* in the spotted-covert subadult breeding plumage are 382039

and 397072. Neither *H. u. ustulata* nor *H. u. oedica* is represented in the collection in this plumage.

Adult females in fresh plumage: *Hylocichla ustulata ustulata*: The upperparts are paler, slightly greener in hue than those of adult males of the same season of the year; 156436 is an example. *H. u. oedica* is not represented in the collection in this particular plumage. Specimens of *almae* of this sex and age group were not well represented in the collections which I studied, and the diagnostic coloration which is indicated below may be open to correction; the two specimens which I examined (397775 and 466951) are characterized by a pronounced grayish-olive overcast, strikingly different from other plumages of either sex or race. Females of *swainsoni*, on the other hand, are bright reddish olive above and are quite similar to the Dresden Brown of Ridgway; representatives of this group are 164179, 175847, 363970, and 375972.

Subadult females in fresh plumage: *Hylocichla ustulata ustulata* and *H. u. oedica*: None seen. *H. u. almae*: Specimens of this age and sex group possess the darkest dorsal coloration of any specimens in fall plumage; I would call it dark reddish brown, although the Brownish Olive of Ridgway is quite close but perhaps a little too saturated. 397618 and 419144 are examples of this plumage type. *H. u. swainsoni*: Specimens are quite reddish olive above; they are definitely more reddish olive above than males in fresh fall plumage, but on the other hand they are slightly paler than adult females in the fall. Some examples are 362315, 404722, 460530, and 479755.

Adult females in breeding plumage: *Hylocichla ustulata ustulata*: Similar to males but slightly richer in hue. 157768, 166909, and 156357 are examples. *H. u. oedica*: Paler and grayer than males in the same plumage; this plumage may be represented by specimens 420625, 262239, and 258364. The females of both of the following races are similar to the adult males in breeding plumage: *H. u. almae* may be represented by 242895, 269731, 367532, and 7170 (ING). *swainsoni* is represented by 348507, 382046, 425094, and 6836 (ING).

Subadult females in breeding plumage: *Hylocichla ustulata ustulata* and *H. u. oedica*: None seen. Specimens of *almae* are similar to adults but with slight reddish wash to the upperparts. They may be represented by the Brownish Olive of Ridgway, and are paler, less saturated than fall subadults females. Specimens of *swainsoni* in subadult female breeding plumage are more reddish above than adults but considerably paler than first-year males which are extremely dark in this plumage; specimens selected at random are 382042, 382049, and 397075.

Nongeographic Variation

Moults and plumages: I believe that Dwight (1900) is essentially correct in his diagnosis of the moults of Swainson's thrush. There is no prenuptial moult but some birds go through a "brightening" stage in which the upperparts acquire a rich, bright hue. At first glance, it might appear that the bird had just completed a prenuptial moult, but observation under a low-powered binocular-microscope reveals that the feathers are considerably worn. Miller (1941, p. 181) observed that some races of juncos undergo a similar brightening stage. There is a sequence of abrasion to the feathers of the upperparts that is helpful in segregating specimens in breeding plumage. Females arrive on the breeding ground later than males (sometimes as much as two weeks) and do not begin to show signs of wear until another week or ten days has passed, where as males begin to show signs of wear (sometimes going through a "brightening" stage) almost as soon as they arrive on territory. Specimens of subadult birds taken in spring migration are invaribly more worn than adult birds taken during the same season. There is evidence that both age groups go through a prenuptial moult of the tail feathers (239929 and 208991), sometimes extending well into the breeding season (187190 and 187176).

Age of museum skins: Many of the specimens in the U.S. National Museum are very old. Consequently, the problem of color alteration due to age was given special attention. A series of skins known to be badly foxed were used as a control group. Foxing produces a peculiar artificially dyed appearance to the plumage that is at once apparent after a little experience is gained in recognizing this type of pigment alteration. As a secondary result of having the control series available, it was determined that several birds collected on the east coast and labelled "*ustulata*" were actually foxed specimens of *swainsoni*. These were 236009, female, Sept. 18, 1881, Highland Falls, N.Y., E. A. Mearns; and 263403, sex unknown, Sept. 21, 1897, Ariel, Amite Co., Miss., collected by A. Allison.

Ecological Comments

With the possible exception of the race *H. u. oedica*, the nest-site requirements of Swainson's thrush are almost invariably associated with the northern and mountain coniferous forest climaxes and their subclimaxes. In general, *H. u. ustulata* shows a decided preference for the deep forests of the Humid Transition Zone west of the Cascades in Oregon and Washington and the Coast Ranges of British Columbia. Here the heavy rainfall produces a rain forest of almost impenetrable undergrowth that is dominated by a climax forest of Sitka spruce,

western hemlock, western red cedar, and grand fir. Subclimax associates are dominated by Douglas-fir.

H. u. swainsoni prefers both climax and subclimax forests of the Canadian Zone. Their habitat requirements show some variation in different parts of their range, for, according to Bent (1949, p. 175), "this thrush is less common in mature dense coniferous forests than in bordering growths of smaller trees, where young balsam firs are growing up with a mixture of birches." Again, referring to northern New England, he said "they prefer the spruce and fir forests of the Canadian Zone."

H. u. almae occupies a broad range of climax and subclimax forested areas across the Canadian, Transition, and lower Hudsonian Zones. Among the dominants found in this area are black, white, and Englemann spruce and lodgepole pine.

H. u. oedica prefers the less humid areas of the Pacific Coast States and is found in the Transition Zone where yellow pine predominates and where strips of willow, cottonwood, and white alder provide nesting sites along foothill, valley, and streamside lowlands.

Summary

To reevaluate the criteria purported to be significant in segregating the various races of Swainson's thrush 513 specimens were assembled. Birds from Alaska south through the Rocky Mountains to Colorado were found to have a grayish-olive dorsal coloration, while the upperparts of birds from the Athabaska River in Alberta eastward to Newfoundland and south to West Virginia exhibited a more reddish-olive coloration.

Hylocichla ustulata oedica Oberholser is considered a valid race and as a consequence the nominate form *H. u. ustulata* is restricted to the Pacific coast from northwestern Oregon to Juneau, Alaska.

The terminal population, *H. u. clarescens*, described by Burleigh and Peters from Newfoundland, is not considered sufficiently distinct from the mainland form *H. u. swainsoni* to be given nomenclatural recognition. The subspecies *H. u. incana*, described by Godfrey in 1951 from the Yukon Territory, is considered a synonym of *H. u. almae* Oberholser, 1898.

H. u. almae does not normally occur along the Atlantic coast during migration. There are, however, a number of records from southern Illinois and the Gulf States which suggest that the Mississippi Valley may be a major flyway for this subspecies in the spring and fall.

Several specimens labelled "*ustulata*" taken along the Atlantic and Gulf coasts were found to be foxed specimens of *swainsoni*. This error suggests that all former records of the Pacific coast race taken in the east should be re-examined for possible misidentification.

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REVIEW OF THE HAWKFISHES (FAMILY CIRRHITIDAE)

By JOHN E. RANDALL [1]

The Cirrhitidae is a family of 10 genera and 34 species of carnivorous fishes, usually small and often colorful, which inhabit warm seas. One of the genera and six of the species are herein described as new. The family is characterized as follows: pectoral fins with 14 rays, the lower 5 to 7 rays unbranched and usually enlarged with membranes deeply incised; 1 dorsal fin, notched between spinous and soft portions, with 10 spines and 11 to 17 rays (the spinous portion, however, of greater basal length than the soft); anal fin with 3 spines and 5 to 7 (usually 6) rays; 15 principal caudal rays; 6 branchiostegal rays; pelvic rays I,5; 1 or more cirri projecting posteriorly from interspinous membranes near tips of dorsal spines; a fringe of cirri on hind edge of anterior nostril; gill membranes broadly joined with a free fold across isthmus; no air bladder; 26 vertebrae.

[1] Contribution No. 409 from The Marine Laboratory, University of Miami. Author now Professor of Biology, University of Puerto Rico, Mayagüez, Puerto Rico.

With the exception of the presence or absence of palatine teeth, the dentition of cirrhitids is relatively unchanging from species to species. Teeth are present on the vomer. There is a row of canine teeth in both jaws which are usually longer anteriorly in the upper jaw; the longest canines in the lower jaw are usually a group of 2 to 4 on each side about half way back in the series of teeth. A band of small villiform teeth, broader anteriorly, occurs inside the canines of the jaws (restricted to front of lower jaw). Additional characteristics and discussion of the closely related families Chironemidae, Aplodactylidae, Cheilodactylidae, and Latrididae are given by Regan (1911).

Hawkfishes occur mostly in shallow water, often only a few feet deep. Species of the genera *Oxycirrhites* and *Cyprinocirrhites*, however, appear to live primarily at depths of about 15 to 60 fathoms. The shallow-water cirrhitids, at least, dwell upon the bottom as do the related scorpaenids. The thickened condition of the lower pectoral rays may be an adaptation for the demersal habit, inasmuch as the lower part of these fins makes contact with the coral or rock substratum. In general, the cirrhitids are more active than the scorpaenids and frequently move short distances from one part of a reef to another. Some smaller species commonly seek refuge in interstices of living coral. Chacko (1949), Randall (1955), and Hiatt and Strasburg (1960) reported on the food habits of some of the cirrhitids.

The Cirrhitidae is dominantly an Indo-Pacific family. Only 2 species are known from the Atlantic, 1 from west Africa and the other from the West Indian region. Within the vast Indo-Pacific area the number of cirrhitid fishes recorded from subregions or island groups in the last 2 decades is as follows: western Indian Ocean, 9 (Smith, 1951); East Indies, 10 (de Beaufort, 1940); Philippine Islands, 5 (Herre, 1953); Phoenix and Samoa Islands, 7 (Schultz, 1943); Gilbert Islands, 5 (Randall, 1955); Marshall Islands, 6 (Schultz *in* Schultz and collaborators, 1960); Hawaiian Islands, 5 (Gosline and Brock, 1960).

To obtain the above numbers of species, the following allocation of certain nominal and valid species must be considered: *Cirrhitus mossambicus* Smith has been referred to the synonymy as a juvenile of *C. nigropunctatus* Schultz (=*Cirrhitus punctatus* Cuvier *in* Cuvier and Valenciennes) by Schultz *in* Schultz and collaborators, 1960. *Cirrhitichthys aprinus* (Cuvier), a name applied by most recent authors to *C. oxycephalus* (Bleeker), is distinct from *oxycephalus*. *Paracirrhites polystictus* (Günther) appears to be a color phase of *P. hemistictus* (Günther) (Marshall, 1950). *Amblycirrhitus oxyrhynchos* (Bleeker)

and *Paracirrhites amblycephalus* (Bleeker), placed in synonymy by de Beaufort (1940) and other authors, are valid species.

Specimens of 12 species of hawkfishes were collected in French Oceania (Society Islands, Marquesas Islands and Tuamotu Archipelago) and nearby Caroline Atoll (10° S., 150° W.) by the author in 1956 and 1957. These have been deposited in the U.S. National Museum under numbers 190564 to 190586 and the George Vanderbilt Foundation, Stanford University (SU). Analysis of these collections has led to the present review of the family.

That southeastern Oceania should have more species of cirrhitid fishes than the East Indies or Philippines is contrary to the usual faunal picture wherein the number of species in a group is greatest in the Indo-Malayan region and diminishes eastward. This apparent contradiction with respect to the distribution of cirrhitids probably reflects a greater collecting effort in Oceania.

All available specimens of the Cirrhitidae deposited at the following institutions have been examined: U.S. National Museum (USNM), Academy of Natural Sciences of Philadelphia (ANSP), American Museum of Natural History (AMNH), Museum of Comparative Zoology at Harvard University (MCZ), Bingham Oceanographic Laboratory at Yale University (BOC), Marine Laboratory of the University of Miami (UMML), Muséum National d'Histoire Naturelle in Paris (MNHN), and Museu e Laboratório Zoológico in Lisbon.

Assistance of the curators of fishes of these institutions and especially of the staff of the Division of Fishes of the U.S. National Museum is gratefully acknowledged; that institution provided working quarters for the author during part of the study, and its material of the Cirrhitidae formed much of the basis for this revision.

Thanks are due W. J. Baldwin of the University of California at Los Angeles, M. L. Bauchot of the Muséum National d'Histoire Naturelle in Paris, M. Boeseman of the Rijksmuseum van Natuurlijke Historie at Leiden, E. H. Bryan, Jr. of the Bernice P. Bishop Museum in Honolulu, K. Deckert of the Zoologisches Museum in Berlin W. A. Gosline of the University of Hawaii (UH), T. Kamohara of Kochi University, W. Klausewitz of the Senckenberg Museum at Frankfurt, T. Monod of the Université de Dakar, J. Nielsen of the Universitets Zoologiske Museum at Copenhagen, R. Rosenblatt of the Scripps Institution of Oceanography (SI), D. W. Strasburg of the U.S. Fish and Wildlife Service in Honolulu, M. Torchio of the Museo Civico di Storia Naturale in Milan, A. C. Wheeler and N. B. Marshall of the British Museum (Natural History) (BM), G. P. Whitley of the Australian Museum, and L. P. Woods of the Chicago Natural History Museum for information on specimens and loans. Drawings

of new species were made by Fanny L. Phillips; the photographs were taken by the author.

Standard length was taken from the front of the upper lip with mouth closed to the base of the caudal fin (that is, end of hypural plate). Head length was measured from the front of the upper lip to the most posterior part of the opercular membrane, snout length from the front of the upper lip to the edge of the eye, and length of caudal peduncle from a vertical at rear base of dorsal fin to base of caudal fin. All fin rays that have a separate basal element, regardless of spacing, were counted. Scale rows above the lateral line were counted in the middle of the body. Only the rows of large scales were counted; once a row of scales showed a marked diminution in size to the row beneath it, it was not counted. If the scale rows are counted from the lateral line to the origin of the dorsal fin, there is often one scale more than may be counted in the middle of the body. Gill-raker counts include rudiments. Capped roman numerals designate spines and lowercase roman numerals unbranched soft rays (pectoral counts only). The number of serrations on the free margin of the preopercle increase with age (fig. 1); therefore, this count is often without value unless lengths of specimens are given. The number of specimens on which meristic data are based is enclosed in parentheses after the counts in species discussions, along with locality or localities of these specimens. All counts are included in species diagnoses, although not all are diagnostic. Characters given in the diagnoses and key to genera are usually not repeated in species accounts.

Key to the Genera of the Cirrhitidae [2]

1a. Scales ctenoid; 3 spines on opercle; 2 rows of scales above lateral line (subfamily ISOBUNINAE) . . . . . **Isobuna** (p. 393)

1b. Scales cycloid; 2 indistinct flattened spines on edge of opercle; 3 to 5 rows of scales above lateral line (subfamily CIRRHITINAE).

2a. Snout not elongate, its length about 3 to 5 in head length; body not slender, the depth 2 to 3.4 in standard length; canine teeth in jaws markedly longer than inner villiform teeth, those at front of upper jaw and side of lower jaw enlarged.

3a. Caudal fin rounded, truncate, or slightly emarginate; dorsal soft rays 11 to 15.

4a. No large scales on cheek (small scales in more than 12 irregular rows).

5a. Body not deep and not compressed, the depth 2.6 to 3.4 in standard length and the width 1.5 to 1.9 in depth; dorsal soft rays 11 (rarely 12); palatine teeth present; upper margin of preopercle finely serrate or smooth; lower 7 pectoral rays unbranched. **Cirrhitus** (p. 395)

[2] The Japanese genus *Serranocirrhitus* Watanabe (1949), no specimen of which has been examined, is not considered in the present paper. Although this genus may ultimately be placed in the Cirrhitidae as intended by Watanabe, it differs notably from other cirrhitids in having all the pectoral rays unbranched and not thickened, no teeth on the vomer, and the configuration of a pomacentrid. Like *Isobuna*, it has ctenoid scales.

5b. Body deep and compressed, the depth 2 to 2.4 in standard length and the width 2.9 to 3.1 in depth; dorsal soft rays 13; palatine teeth absent; upper margin or preopercle coarsely serrate; lower 6 pectoral rays unbranched . . . . . **Neocirrhites** (p. 403)

4b. Rows of large scales on cheek 4 to 6 (small scales also usually present).

6a. Rows of large scales between lateral line and spinous portion of dorsal fin 5; a single cirrus from membrane near tip of each dorsal spine; membranes of spinous portion of dorsal fin not deeply incised, those between longest dorsal spines extend four-fifths or more of distance from base to tips of spines; palatine teeth absent. **Paracirrhites** (p. 404)

6b. Rows of large scales above lateral line in middle of body 3 or 4; a tuft of cirri from membrane near tip of each dorsal spine; membranes of spinous portion of dorsal fin deeply incised, those between longest spines extend less than two-thirds of distance from base to tips of spines; palatine teeth present or absent.

7a. Dorsal soft rays 14 (rarely 15); first 2 pectoral rays unbranched; free posterior margin on preorbital; interorbital not scaled; snout not pointed, the profile from interorbital to upper lip convex. . . . . **Cirrhitops** (p. 419)

7b. Dorsal soft rays 11 or 12 (rarely 13); first pectoral ray unbranched, second usually branched; free posterior margin on preorbital present or absent; interorbital scaled or not scaled; snout pointed or not pointed.

8a. Palatine teeth absent; longest dorsal spine 3.5 to 4 in depth; snout not pointed, profile from interorbital to upper lip convex . . . . . **Isocirrhitus,** new genus (p. 422)

8b. Palatine teeth present; longest dorsal spine 1.7 to 3.2 in depth; snout pointed, profile from interorbital to upper lip nearly straight.

9a. Preopercular margin finely serrate; preorbital without a free hind margin; interorbital scaled; first dorsal soft ray not produced into a filament; lower 5 (rarely 6) pectoral rays unbranched . . . . . **Amblycirrhitus** (p. 423)

9b. Preopercular margin coarsely serrate; preorbital with hind margin free for about ¼ to ½ distance from lower edge to eye; interorbital not scaled; first dorsal soft ray usually produced into a filament; lower 6 or 7 pectoral rays unbranched . . . . . **Cirrhitichthys** (p. 429)

3b. Caudal fin lunate, the lobes produced; dorsal soft rays 16 or 17. **Cyprinocirrhites** (p. 443)

2b. Snout elongate, its length about 2 in head length; body slender, the depth 4.4 to 4.6 in standard length; canine teeth in jaws only slightly longer than inner villiform teeth and nearly uniform in size. **Oxycirrhites** (p. 445)

Subfamily Isobuninae

Genus *Isobuna* Jordan

Isobuna Jordan, *in* Jordan and Herre, 1907, Proc. U.S. Nat. Mus., vol. 33, p. 158. (Type species, *Paracirrhites japonicus* Steindachner, by original designation and monotypy. New name for *Paracirrhites* Steindachner, preoccupied by *Paracirrhites* Bleeker.)

Isobuna is apparently known from one specimen of a single species, *japonica* Steindachner (for a description, see species account below), which was deposited in the Museo Civico di Storia Naturale in Milan, Italy; M. Torchio of this institution has written that he is unable to locate the type and is certain that it was destroyed as a result of bombardment during World War II. It has not been illustrated.

Of this genus, Smith (1951, p. 626) stated, "If it is a cirrhitid, *Isobuna* would merit subfamily rank." It is here considered as a subfamily of the Cirrhitidae, but not with assurance. With its ctenoid scales, three opercular spines, large mouth, and lower pectoral rays unbranched but not thickened, it may represent primitive stock of the family, and it seems to link the Cirrhitidae with the Serranidae.

Isobuna japonica (Steindachner)

Paracirrhites japonicus Steindachner, *in* Steindachner and Döderlein, 1884, Denkschr. Akad. Wiss. Wien, vol. 48, p. 25 (type locality, Japan).

DESCRIPTION.—Dorsal rays X,15; anal rays III,7; lower 6 or 7 pectoral rays unbranched; lateral-line scales 33 or 34; 2 scales above lateral line; 10 scales below lateral line.

Head length slightly more than 2½ and body depth almost 2⅔ in body length. Eye 5, interorbital 8, and snout including lower jaw nearly 4 in head length.

Body compressed; upper profile of head and body moderately arched; snout pointed, the lower jaw projecting slightly; ventral outline to anal fin nearly straight. Mouth large, oblique, the maxillary extending a little beyond posterior edge of eye; teeth in jaws slender, pointed, those of outer row slightly longer and stouter than those of inner row; a small canine on each side at front of premaxillary; teeth on vomer and palatines; free preopercular margin rounded and finely serrate; operculum terminates in 3 short spines, the middle one the sharpest; lateral line almost parallel to base of dorsal fin; scales ctenoid; head scaled except for lips and a narrow band on snout to nostrils; scales on cheek and operculum large, those on top of head small; basal part of fins scaled; dorsal fin deeply notched between spinous and soft portions; fifth and sixth dorsal spines the highest, their length two-sevenths head length; last dorsal spine equal in height to first and about half diameter of eye; first soft ray as long as longest dorsal spine; the following rays up to the eighth increase gradually in length, the eighth 2⅛ in head length; remaining rays decrease gradually in length, the last 3 times in head; caudal fin weakly concave, its length 1⅞ head length. Second anal spine longer and stouter than other spines, its length slightly longer than longest dorsal spine; fourth soft ray of anal fin the longest, its length half the head length; pelvic fins not quite reaching anus, their origin in

front of lowest pectoral rays; eighth and ninth rays of pectoral fins the longest, reaching to a vertical at base of fourth anal soft ray; length of pectoral fins 1⅛ length of pelvic fins, 1½ in head length.

Color yellowish brown with a diffuse golden yellow spot in the center of each body scale (after Steindachner).

Described from a single 150 mm. specimen from Japan. The total number of pectoral rays, number of gill rakers, number of vertebrae, presence or absence of air bladder, and presence or absence of cirri distally on dorsal fin membranes and at rear edge of anterior nostril are not known.

Subfamily Cirrhitinae

Genus *Cirrhitus* Lacépède

Cirrhitus Lacépède, 1803, Histoire naturelle des poissons, vol. 5, p. 2. (Type species, *Cirrhitus maculatus* Lacépède by monotypy = *Labrus pinnulatus* Schneider. Spelled *Cirrhites* by some authors.)

DIAGNOSIS.—Uppermost and lower 7 pectoral rays unbranched; dorsal soft rays 11 or 12; palatine teeth present; upper margin of preopercle finely serrate or smooth; preorbital without a free hind edge; small scales on cheek; 4 rows of large scales above lateral line in middle of body; depth of body 2.6 to 3.4 in standard length; snout length 2.7 to 3.8 in head length; a tuft of cirri from membrane near tip of each dorsal spine; membranes of dorsal fin not deeply incised, the one between fifth and sixth spines notched one-third or less of the length of the spines; longest dorsal spine 2.2 to 3 in body depth; pectoral fins do not reach origin of anal fin; pelvic fins reach or nearly reach anus; caudal fin slightly emarginate to slightly rounded.

Key to the Species of *Cirrhitus*

1a. Lateral-line scales 38 to 44.

2a. Supraorbital ridge low; pectoral fins not reaching vertical at tips of pelvic fins; longest unbranched pectoral rays only slightly longer than longest branched rays.

3a. Supraoccipital crest visible as a low ridge; no scales on interorbital space; no small white spots on head, body, and fins (white blotches nearly as large as eye present on body) (Indo-Pacific) . . **pinnulatus**

3b. Supraoccipital crest not visible externally; a narrow median band of scales on interorbital space; small white spots on head, body, and fins, those on body arranged in about 12 lengthwise rows (Niuafoo Island, near Tonga Islands) . . . . . **albopunctatus**

2b. Supraorbital ridge high and prominent; pectoral fins reach slightly posterior to vertical at tips of pelvic fins; longest unbranched pectoral rays nearly one-third longer than longest branched rays.

4a. Supraorbital crest not hooklike and extending more than half an eye diameter in distance posterior to eye; scales on thorax not markedly

smaller than those on rest of body; dorsal soft rays 11; upper two-thirds of body, head, and pectoral base with scattered small solid black spots (western Indian Ocean) . . . . . **punctatus**

4b. Supraorbital crest slightly hooked posteriorly and extending only slightly posterior to eye; scales on thorax markedly smaller than those on rest of body; dorsal soft rays 12; no small solid black spots on upper part of body or head (Lord Howe Island) . . . . . **splendens**

1b. Lateral-line scales 45 to 49.

5a. Depth of body 2.6 to 2.8 in standard length; longest dorsal spine about 3.3 in head length; 5 near-vertical dark bars on body of young which break up into groups of irregular oblong spots with bicolored border (black inwardly and pale outwardly) on adults; dark bands on head with similar border (tropical eastern Pacific) . . . . . **rivulatus**

5b. Depth of body about 3 in standard length; longest dorsal spine about 2.4 in head length; color pattern not of dark bars or oblong black spots arranged in bars (Ilheo das Rolas, tropical west Africa) . . **atlanticus**

Cirrhitus pinnulatus (Schneider)

FIGURE 2

Labrus pinnulatus Schneider, *in* Bloch and Schneider, 1801, Systema ichthyologiae . . . , p. 264 (type locality, Tahiti).

Labrus marmoratus Lacépède, 1802, Histoire naturelle des poissons, vol. 3, pp. 438, 493, pl. 5, lower figure (no locality).

Cirrhitus maculatus Lacépède, 1803, Histoire naturelle des poissons, vol. 5, pp. 2, 3 (type locality, Mauritius).

Cirrhites maculosus Bennett, 1828, Zool. Journ., vol. 4, p. 38 (type locality, Hawaiian Islands).

Cirrhitus alternatus Gill, 1862, Proc. Acad. Nat. Sci. Philadelphia, vol. 14, pp. 106, 107 (type locality, Hawaiian Islands).

Cirrhitus spilotoceps Schultz, 1950, Proc. U.S. Nat. Mus., vol. 100, pp. 548, 551, pl. 13,C (type locality, Red Sea).

DIAGNOSIS.—Dorsal rays X,11; anal rays III,6; pectoral rays i,6,vii; lateral-line scales 39 to 44 (table 1); 4 rows of large scales above lateral line in middle of body (3 beneath soft portion of dorsal fin); 9 large scales below lateral line to origin of anal fin; gill rakers 5 to 7+1+11 to 13 (29 specimens, localities of table 1).

TABLE 1.—*Counts of lateral-line scales of specimens of* Cirrhitus pinnulatus

Locality	Lateral-line scales (both sides counted)					
	39	40	41	42	43	44
Hawaiian Islands	4	8	4	1	1	-
Gilbert, Marshall and Tuamotu Islands	5	11	8	2	-	-
Mauritius	1	2	1	-	-	-
Red Sea	-	-	-	3	4	1

Supraorbital ridge low; supraoccipital crest visible as a low ridge; pectoral fin tips do not reach vertical at distal ends of pelvic fins; interorbital not scaled; depth of body about 3 in standard length.

Color in alcohol brown with 3 rows of 5 or 6 white spots of the size of the eye or slightly smaller; brown area of body overlaid with close-set dark brown spots; head with dark brown blotches or irregular bands, usually the most prominent being a dark blotch behind lower edge of eye; a dark spot medially on chin adjacent to lower lip, rimmed posteriorly by an arc of dark brown; dorsal cirri white. In life the dark brown spots on the body are brownish red, the markings on the head orange-brown, and the abdomen white.

A 22-mm. juvenile from Morotai, East Indies (USNM 147682), is colored nearly like adults. The rows of white spots are more prominent; the intervening brown areas are dark and no darker spots are visible on them; the darkest marking is a broad extension of dark brown into base of dorsal fin at juncture of spinous and soft portions.

Remarks.—A wide-ranging species, *C. pinnulatus* is known throughout the Indo-Pacific. Jordan and Herre (1907) and Kamohara (1954) have recorded it from southern Japan. The author collected it in Hawaii, Gilbert Islands, Society Islands, and Tuamotu Archipelago. It is an inshore species, characteristically found in a region subject to wave action. Klunzinger (1870) and Harry (1953) have pointed out that this hawkfish hides in crevices on the reef front by day and forages on the reef by night.

The type of *pinnulatus* was not located; it is not in the Berlin museum. A specimen listed as the type of *maculatus* Lacépède from Mauritius via Dussumier (MNHN 2775) proved to be the same as *pinnulatus*. M. L. Bauchot of the Paris museum has informed the author that the true type of *maculatus* should be the *maculatus* of Commerson whose manuscript was the basis for Lacépède's name. She located this specimen (MNHN 5449A), a dried half-example measuring 172 mm. in standard length. Although no color pattern is apparent, the specimen is evidently conspecific with *pinnulatus*.

Schultz (1950; pp. 548, 551, pl. 13,C) noted slight differences in the number of lateral-line scales, gill rakers, and color of *pinnulatus* in the Red Sea. The scale counts of Red Sea specimens are higher (see table 1), and the gill rakers on the lower limb of the first arch seem to be slightly higher (12 or 13, as opposed to 11 or 12); the brown spots on the cheek, snout, and upper lip are more numerous and more distinct. Schultz has assigned the specific name *spilotoceps* to this geographical variant. I would prefer to utilize this name for subspecific designation.

Some authors have applied the name *alternatus* Gill to *pinnulatus* in Hawaii. The differentiation of the Hawaiian form is less marked

than that of the Red Sea form. Color differences are slight; there appear to be 5 or 6 gill rakers on the upper limb of the gill arch instead of 6 or 7. Should a name be desired for the Hawaiian variant, *maculosus* Bennett (1828) would have priority over *alternatus*.

In the same year that Bennett proposed *maculosus*, Rüppell applied this name to *pinnulatus* in the Red Sea; however he attributed *maculosus* to Lacépède. Lacépède's name was *maculatus*. In a later work Rüppell (1835, p. 95) indicated this mistake to be a printer's error.

Largest specimen examined, 230 mm. in standard length, from Hawaii.

Cirrhitus albopunctatus Schultz

FIGURE 3

Cirrhitus albopunctatus Schultz, 1950, Proc. U.S. Nat. Mus., vol. 100, pp. 547, 548, pl. 13,A (type locality, Niuafoo Island, near Tonga Islands).

DIAGNOSIS.—Dorsal rays X,11 or 12; anal rays III,6; pectoral rays i,6,vii; lateral-line scales 39 to 42; 3 rows of large scales above lateral line in middle of body (4 beneath most of spinous portion of dorsal fin); 9 scales below lateral line to origin of anal fin; gill rakers 7+1+10 or 11 (2 specimens).

Supraorbital ridge low and not extending posterior to eye; supraoccipital crest not visible externally; pectoral fins do not reach a vertical at tips of pelvic fins; interorbital with a narrow median band of small scales; depth of body about 3.1 in standard length; caudal fin slightly rounded; snout length 3.5 in head length (3 to 3.3 for other species of *Cirrhitus*); suprascapular margin smooth (serrate on other species of *Cirrhitus*, although reduced on *pinnulatus*) (*atlanticus* not checked).

Color in alcohol brown with small white spots on head, body, and fins, those on body in about 12 rows. These small white spots are superimposed on a pattern of about 4 rows of pale spots about the size of the eye, the 2 most prominent spots being at the base of the caudal fin; uppermost of these 2 white spots edged with dark brown blotches, the largest of which lies dorsally on caudal peduncle.

REMARKS.—Known from 2 specimens from Niuafoo Island near the Tonga Islands, the holotype (USNM 91883), 101 mm. in standard length and an 80 mm. paratype, now in the Museum of Comparative Zoology at Harvard University.

Cirrhitus punctatus Cuvier

FIGURE 4

Cirrhites punctatus Cuvier, *in* Cuvier and Valenciennes, 1829, Histoire naturelle des poissons, vol. 3, p. 70 (type locality, Madagascar).

Cirrhites punctatus Bleeker, 1866, Nederlandsch Tijdschr. Dierk., vol. 3, p. 176 (Réunion).

Cirrhitus nigropunctatus Schultz, 1950, Proc. U. S. Nat. Mus., vol. 100, pp. 547, 549, pl. 13,B (type locality, Mauritius).

Cirrhitus mossambicus Smith, 1951, Ann. Mag. Nat. Hist., ser. 2, vol. 4, p. 629, fig. 1 (type locality, Mozambique Island, east Africa).

DIAGNOSIS.—Dorsal rays X,11; anal rays III,6; pectoral rays i,6,vii; lateral-line scales 40 to 43; 4 rows of large scales above lateral line in middle of body; 9 large scales below lateral line to origin of anal fin; gill rakers 6 or 7+1+10 or 11 (5 specimens, Mauritius and Madagascar).

Prominent bony supraorbital ridge extending more than half an eye diameter posterior to eye; pectoral fins reach beyond tips of pelvic fins; interorbital scaled; depth of body 3.14 to 3.35 in standard length; caudal fin truncate to slightly rounded.

Color in alcohol: upper half of body with large dark and pale blotches forming 5 alternate dark and light bars, lower half pale with a series of 5 dark blotches; upper two-thirds of body, head, and pectoral base with scattered small dark brown or black spots; a curved dark line extending posteriorly from eye; a dark blotch on lower lip; all fins blotched with dark brown.

REMARKS.—The type of *punctatus* (MNHN 2772) was obtained from Madagascar by Quoy and Gaimard. The following counts and measurements were made from the specimen: lateral-line scales 43; gill rakers 6+1+10; standard length 136 mm., total length 167 mm., depth 43.5 mm., head length 51.5 mm., eye diameter 9.5 mm., length of pectoral fin 41 mm., longest dorsal spine (the third) 19 mm. Sixteen canine teeth on one side at front of upper jaw; 6 lower canines, the last 2 the longest, followed by 11 shorter, more slender teeth of about equal height. Inner rows of villiform teeth extend the length of upper jaw but are restricted to anterior part of lower jaw; palatine teeth in 2 short anterior irregular rows.

Another specimen in the museum in Paris is also listed as a type. This is a dried, varnished, 132.5-mm. half-specimen, with a locality of "Mer des Indes" (Indian Ocean) and attributed to Commerson. The Madagascar specimen is well preserved in alcohol and is here designated lectotype.

The largest specimen examined, 149 mm. in standard length, is a paratype of *nigropunctatus* Schultz from Mauritius in the Museum of Comparative Zoology at Harvard University. The holotype of *nigropunctatus* was examined and photographed in the U.S. National Museum.

The species is apparently known only from the localities listed in the citations above, which suggest that it is restricted to the western Indian Ocean.

Cirrhitus splendens (Ogilby)

FIGURE 5

Cirrhitichthys splendens Ogilby, 1889, Mem. Australian Mus., no. 2, p. 58, pl. 2 (type locality, Lord Howe Island).

DIAGNOSIS.—Dorsal rays X,12; anal rays III,6; pectoral rays i,6,vii; lateral-line scales 43; 4 rows of large scales above lateral line in middle of body; 9 scales below lateral line to origin of anal fin; gill rakers 5+1+10 (1 specimen).

Bony supraorbital ridge moderately high, the hind edge slightly hooked (that is, upper portion overhanging base), but extending only slightly posterior to eye; scales on thorax markedly smaller than those on rest of body (scales essentially the same size on thorax as on body of other species of *Cirrhitus*) (*atlanticus* not checked); pectoral fins extending beyond pelvic fin tips and posterior to anus, but do not reach origin of anal fin; longest unbranched pectoral ray nearly one-third longer than longest branched ray; interorbital deeply concave, unscaled; snout length about 2.7 in head length; longest dorsal spine about 2.2 in body depth; depth of body about 3.2 in standard length; small scales on thorax like those on cheek; first dorsal soft ray noticeably longer than remaining rays (decidedly longer on type) (other species of *Cirrhitus* lack prolonged first dorsal soft rays); upper half of preopercular margin with 26 serrations which are larger than those in species of *Cirrhitus* with serrations on the preopercle but still small compared to those in species of *Cirrhitichthys;* suprascapula with 16 serrations.

Color in alcohol brown, with 5 indistinct broad darker brown bars on about upper two-thirds of body, the last on caudal peduncle representing an aggregation of 6 dark brown spots, 3 above and 3 below lateral line; each broad bar of body divides below lateral line to 2 or 3 lesser bars (this pattern obscure for first 2 bars); head entirely covered with dark-edged pale spots the size of pupil or smaller except for a horizontally elongate one posterior to eye, a transversely elongate one on occipital part of head, and a bilobed one with broad dark border middorsally on nape; caudal fin pale with elongate black spots arranged in about 3 irregular vertical rows; spinous portion of dorsal fin with a row of 5 large dark-edged pale spots at base; upper triangular portion of each dorsal interspinous membrane black; soft portion of dorsal fin pale, except basal scaled portion which is colored like body; anal and pelvic fins light brown; pectoral fins light brown, faintly spotted basally, except outer two-thirds of the thickened simple lower rays which are abruptly pale.

The life color of the type is given by Ogilby as follows:

The head is rich brown with numerous round crimson black-edged spots, about two-thirds of the size of a body scale; the body is pale yellowish-brown with six

broad dark brown bands which almost totally obliterate the ground color superiorly, but are discontinued on the lower third of the sides, while many of the scales above the lateral line are crimson, occasionally even forming short longitudinal bars, and in front of the bases of the pectorals there are several spots similar to those on the head; the spinous portion of the dorsal fin is mottled with black, crimson, and grey; the soft is light-colored with a broad black basal band, and indications of a dusky median longitudinal band more pronounced posteriorly; the anal fin is reddish brown; the ventral fins are crimson on the inner side, while the pectoral rays are crimson, with the intervening membrane grey; the base of the caudal is crimson, the remainder grey, and it is ornamented with two rows of oblong black spots.

REMARKS.—Apparently only 2 specimens are known, both from Lord Howe Island off Australia. The type, 8¼ in. in length, is catalogued in the Australian Museum as No. I.1841. According to Ogilby, it was caught in "deep water" by hook and line and was "quite unknown to the islanders." The second specimen, 161 mm. in standard length (7¾ inches in total length), was kindly sent on loan to the author by A. C. Wheeler of the British Museum (No. 1926.6.30.88).

Cirrhitus rivulatus Valenciennes

FIGURE 6

Cirrhites rivulatus Valenciennes, 1855, Voyage autour du monde . . . la *Venus*, vol. 5, p. 309, pl. 3, fig. 1 (type locality, Galápagos Islands).

Cirrhitus betaurus Gill, 1862, Proc. Acad. Nat. Sci. Philadelphia, p. 259 (type locality, Cape San Lucas, Baja California).

DIAGNOSIS.—Dorsal rays X,11 or 12; anal rays III,6; pectoral rays i,6,vii; lateral-line scales 45 to 49; 5 rows of large scales above lateral line in middle of body (6 to origin of dorsal fin and 4 beneath most of soft portion of dorsal fin); 9 scales below lateral line to origin of anal fin; gill rakers 5 to 7+1+10 to 12 (rarely 12) (14 specimens, Panama, Mexico, and Clipperton Island).

Bony supraorbital ridge low; pectoral fins do not reach tips of pelvic fins; interorbital on adults not scaled, covered with tiny papillae (juveniles seem to have a few imbedded scales on interorbital space); depth of body 2.6 to 2.8 in standard length (3 to 3.4 for other species of *Cirrhitus*); snout length of adults about 3 in head length (about 3.3 in small juveniles); longest dorsal spine about 3 in depth (4 on large adults) (2.2 to 2.7 for other species of *Cirrhitus*); caudal fin of juveniles slightly emarginate, of adults slightly rounded; upper margin of preopercle of juveniles with fine serrations, smooth on adults.

Color in alcohol brown, with irregular but usually vertically elongate spots with dark inner and pale outer edges arranged in 5 near-vertical bars on body (on juveniles these bars are solid dark brown); bands on head, mostly radiating from eye, and at pectoral

base with the same dark inner and pale outer edges; median fins also with irregular spots. Valenciennes described the life color as olive-green, the spots and bands lighter with dark olive inner and cobalt blue outer borders. The fins are olivaceous with blue rivulations.

REMARKS.—The holotype (MNHN A5563) is a dried specimen mounted on wood; the length given by Valenciennes is 445 mm.

C. rivulatus is probably the largest species of the family. Tee-Van (1940) recorded a specimen 450 mm. in total length (his addendum report of a 505-mm. specimen from the Galápagos Islands, USNM 38302, is erroneous; this specimen measures 360 mm. in total length). Another USNM specimen (144465) from Bona Island, Panama is 520 mm. in total length and 430 mm. in standard length.

Gregory (1933; p. 259, fig. 135) has briefly described the osteology of *rivulatus*. Widely distributed in the tropical eastern Pacific.

Cirrhitus atlanticus Osorio

FIGURE 7

Cirrhitus atlanticus Osorio, 1893, Jorn. Sci. Math. Phys. Nat. [Acad. Sci. Lisboa], ser. 2, vol. 3, p. 138 (type locality, Ilheo das Rolas, west Africa).

DIAGNOSIS.—Dorsal rays X,11; anal rays III,6; pectoral rays i,6,vii; lateral-line scales 46 (47); 4 rows of large scales above lateral line in middle of body; 10 scales below lateral line to origin of anal fin; gill rakers 5+1+13 (1 specimen).

Bony supraorbital ridge low and not extending posterior to eye; pectoral fins do not reach tips of pelvics; small scales on interorbital space; depth of body about 3 in standard length; longest dorsal spine about 2.3 in depth; caudal fin slightly emarginate.

Color in alcohol brown, the upper half of the body darker, especially posteriorly, and containing 4 pale blotches at base of dorsal fin; first white blotch centered at base of eighth dorsal spine, the second, somewhat larger (slightly larger than eye) and roughly square in shape, located from base of second to fifth dorsal soft rays, the third at base of last 3 dorsal soft rays, and the last dorsally on caudal peduncle; no irregular white spots on head, as described by Osorio, are now visible, and the row of white spots below the lateral line mentioned in his description is now very faint.

REMARKS.—The type (No. 510), which was examined at the Museu e Laboratório Zoológico in Lisbon, is in good condition. The following measurements and notations were made from the specimen: standard length 155.5 mm.; total length 192 mm.; depth 51 mm.; head 54 mm.; width 23 mm.; eye 9.5 mm.; bony interorbital 8 mm.; pectoral fin 40 mm., longest dorsal spines (fourth to sixth) 22 mm.; first dorsal soft ray 23 mm.; upper margin of preopercle finely serrate,

lower smooth; 7 large scales on opercle with small scales anteriorly and on opercular flap; small scales on interopercle; no scales on gill membranes.

Apparently known only from the type collected at Ilheo das Rolas (0°0′ N., 6°32′ E.), west Africa. The only cirrhitid fish recorded from the eastern Atlantic.

Genus *Neocirrhites* Castelnau

Neocirrhites Castelnau, 1873, Proc. Zool. Acclim. Soc. Victoria, vol. 2, p. 101. (Type species, *Neocirrhites armatus* Castelnau, by monotypy).

Hughichthys Schultz, 1943, U.S. Nat. Mus. Bull. 180, p. 136. (Type species, *Cirrhites melanotus* Günther, by original designation and monotypy).

Generic characters are given in the key to the genera and the diagnosis of the single species, which follows.

Neocirrhites armatus Castelnau

FIGURE 8

Neocirrhites armatus Castelnau, 1873, Proc. Zool. Acclim. Soc. Victoria, vol. 2, p. 101 (type locality, Nob Island, east of Cape Grenville, northeastern Australia).

Cirrhites melanotus Günther, 1874, Fische der Südsee, vol. 1, pt. 3, p. 72, pl. 52, C (type locality, Society Islands).

Paracirrhites melanotus Fowler and Ball, 1925, Bull. B. P. Bishop Mus. 26, p. 16 (Wake Island).

Hughichthys melanotus Schultz, 1943, U.S. Nat. Mus. Bull. 180, p. 136 (Hull Island, Phoenix Islands).

DIAGNOSIS.—Dorsal rays X,13; anal rays III,6 or 7 (one with 7); pectoral rays i,7,vi; lateral-line scales 42 to 45; 4 rows of large scales above lateral line in middle of body (6 to origin of dorsal fin); 10 or 11 scales below lateral line to origin of anal fin; gill rakers 5+1+10 or 11 (12 specimens, Society Islands and Caroline Atoll).

Palatine teeth absent; margin of preopercle with about 12 coarse serrations; preorbital without a free hind margin; small scales on cheek in more than 12 irregular rows; interorbital space not scaled; 4 rows of large scales above lateral line in middle of body (6 to origin of dorsal fin); body deep and compressed, the depth 2 to 2.4 in standard length and the width 2.9 to 3.1 in depth; a tuft of cirri from membrane near tip of each dorsal spine; dorsal spines short, the longest about 3.2 to 3.8 in depth; membranes of dorsal fin not deeply incised, that between fifth and sixth dorsal spines notched less than one-fourth length of spines; first dorsal soft ray not prolonged into a filament; pectoral fins do not reach tips of pelvic fins; pelvic fins reach anus; caudal fin slightly rounded.

Color in alcohol light brown, the upper fifth abruptly dark brown; a large dark brown blotch encircling posterior half of eye; a dark spot on tip of snout and lower lip; fins pale except basal part of dorsal fin which is dark brown.

Color in life of a specimen collected by the author at Caroline Atoll (10°S.,150°W.): body brilliant red except upper fourth to fifth which is dark brown, the demarcation of red and brown not as abrupt as dark and light brown of preserved specimens; head red like body except dorsally on tip of snout, front of lower lip, and a large area adjacent to posterior edge of eye which are dark brown; all fins bright red except dorsal, the spinous portion of which is dark brown up to tips of membranes which are red-orange; soft portion of dorsal fin dark brown on basal third, red-orange on outer two-thirds.

REMARKS.—The type of *armatus* was not located. Gilbert P. Whitley has written that it is not in the Australian Museum. There is no record of it at the Muséum National d'Histoire Naturelle in Paris.

The minute scales on the cheek, lack of teeth on palatines, height a little over 2⅓ in total length, preopercle armed with a series of stout spines, 10 dorsal spines of about equal length except the first which is much shorter, 13 dorsal rays, 6 simple pectoral rays, 43 lateral-line scales, 16 rows of scales in vertical series, and light brownish color with the back darker, all mentioned in the original description by Castelnau, are diagnostic for the hawkfish subsequently named *melanotus* by Günther (1874).

N. armatus is known from northeast Australia, Society Islands, Wake Island, Phoenix Islands and Caroline Atoll. Harry (1953, p. 89) recorded it from Raroia, Tuamotu Archipelago as an undetermined genus and species. Fowler (1931) (after Pohl) listed it from Mortlock (Caroline Islands) by name only.

A small species, the largest specimen examined measures 75 mm. in standard length.

Genus *Paracirrhites* Bleeker

Paracirrhites Bleeker, 1875 Verh. Akad. Wettensch., Amsterdam, vol. 15 (1874), pp. 2, 5. (Type species, *Grammistes forsteri* Schneider, by monotypy).
Gymnocirrhites Smith, 1951, Ann. Mag. Nat. Hist., ser. 12, vol. 4, pp. 627, 638. (Type species, *Cirrhites arcatus* Cuvier, by original designation).

DIAGNOSIS.—Upper 1 or 2 and lower 7 (rarely 6) pectoral rays unbranched; dorsal soft rays 11; palatine teeth absent; upper margin of preopercle very finely serrate or smooth; serration on suprascapula reduced (well-developed in other genera except for *Isocirrhitus* and

some species of *Cirrhitus* and *Amblycirrhitus*); preorbital without a free hind edge; 5 or 6 rows of large scales on cheek; cheek scales with small basal scales; interorbital scaled; 5 rows of large scales above lateral line to spinous portion of dorsal fin (scales in upper row become smaller beneath soft portion of fin); depth of body 2.4 to 3.2 in standard length; snout length 2.7 to 3.6 in head length; a single cirrus from membrane near tip of each dorsal spine; membranes of dorsal fin not deeply incised, the one between fifth and sixth dorsal spines notched less than one-fifth of the length of spines; longest dorsal spine 2.8 to 3.8 in body depth; pectoral fins short, their length about 1.5 to 2 in head length, and not reaching tips of pelvic fins; unbranched pectoral rays only slightly longer than branched rays of fin; caudal fin truncate to rounded.

REMARKS.—Smith (1951) erected the genus *Gymnocirrhites*, designating *arcatus* as the type species. He distinguished it from *Paracirrhites* by the naked membranous fold across the throat and by the lack of scales on the snout before the nostrils. D. W. Strasburg, in an unpublished report on the fishes of the southern Marshall Islands submitted to the Office of Naval Research Aug. 11, 1953, noted the presence of imbedded scales on the gill membranes over the isthmus of some specimens of *arcatus* (and of *hemistictus* as well). Randall (1955, p. 196) placed *Gymnocirrhites* in synonymy. Schultz (Schultz and collaborators, 1960, p. 252) stated that *arcatus* lacks scales on the gill membranes at 48 mm. but has them well developed at 100 mm. standard length. The absence of scales anterior to the nostrils is characteristic of *arcatus*; however, this distinction would not seem to be of generic rank. At least 3 of the 4 other species with postocular marks similar to that of *arcatus* (these species certainly belonging in the same genus as *arcatus*) have scales on the snout anterior to the nostrils (although not as many and none over the median process of the premaxillary as is seen on *forsteri*).

Key to the Species of *Paracirrhites*

1a. Second pectoral ray branched, at least near tip; scales on snout anterior to nostrils; no color mark extending diagonally upward from hind edge of eye.

2a. Ninth and tenth dorsal spines subequal (the tenth slightly longer); lateral-line scales 45 to 49; small dark spots, if present, located on head and anteriorly on body.

3a. Depth of body 2.6 to 2.8 in standard length; small scales on cheek do not separate rows of large scales or adjacent large scales within rows; numerous small dark spots on head and anteriorly on body; no vertical dark bars on body; no pale lines on ventral half of body following scale rows (Indo-Pacific) . . . . . **forsteri**

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3b. Depth of body about 2.9 in standard length; small scales surround large scales on cheek, separating the rows and adjacent scales within rows; no small dark spots visible on head or anteriorly on body; about 9 slightly irregular dark bars on body; ventral half of body with pale lines following scale rows (Nuku Hiva, Marquesas Islands). **typee,** new species

2b. Tenth dorsal spine noticeably longer than ninth spine; lateral-line scales 48 to 51; numerous small dark spots on body, but none on head (central Pacific, excluding Hawaii, and Cocos-Keeling Islands). . **hemistictus**

1b. Second pectoral ray unbranched; no scales on snout anterior to nostrils; a prominent elongate solid or U-shaped mark extending diagonally upward from hind edge of eye.

4a. Three dark-edged pale transverse bands on interopercle; postocular mark not black within U-shaped border; a lengthwise pale band lacking a dark border often present on body; lateral-line scales 45 to 50 (Indo-Pacific) . . . . . **arcatus**

4b. No transverse bands on interopercle; postocular mark dark brown or black within U-shaped border; if a lengthwise pale band is present on body, it is broadly bordered with black; lateral-line scales 48 to 52.

5a. Body uniformly pale or pale with faint lengthwise brown lines following scale rows; lower border of postocular mark does not extend to and beyond lower edge of eye; no dark-edged white spots anteriorly on snout; no markings on maxillary; no white spot in vicinity of anterior nostril.

6a. Posterior margin of caudal fin rounded; postocular mark broader than pupil and originating above center of hind edge of eye; color of body in life orange-red (after Bleeker) (East Indies) . . . **amblycephalus**

6b. Posterior margin of caudal fin straight; postocular mark narrower than pupil and originating at or below center of hind edge of eye; color in life bright yellow (Society and Tuamotu Islands, and Caroline Atoll). **xanthus,** new species

5b. Body not uniformly pale; lower border of postocular spot extends past lower edge of eye almost to upper lip; a pair of dark-edged white spots anteriorly on snout near upper lip; 1 or more small markings on maxillary; anterior nostril nearly enclosed in a white spot.

7a. Body light brown; a lengthwise pale band, broadly bordered with black (except anteriorly), enclosing posterior part of lateral line and running from beneath rear of spinous portion of dorsal fin to middle of caudal fin; upper margin of preopercle smooth or with only a few small serrations (Tuamotu Archipelago) . . . . **nisus,** new species

7b. Body dark brown except caudal peduncle and extreme ventral portion of body posterior to insertion of pelvic fins which are pale yellowish; no lengthwise pale band on body; upper margin of preopercle finely serrate (Caroline Atoll) . . . . . **bicolor,** new species

Paracirrhites forsteri (Schneider)

FIGURE 9

Grammistes forsteri Schneider, *in* Bloch and Schneider, 1801, Systema ichthyologiae . . . , p. 191 (type locality, St. Christine=Tahuata, Marquesas Islands).

Sparus pantherinus Lacépède, 1802, Histoire naturelle des poissons, vol. 4, p. 160, pl. 6, lower figure (no locality).

Gerranus tankervillae Bennett, 1834, A selection of the fishes . . . Ceylon, ed. 2, p. 27, pl. 27 (type locality, Ceylon).

DIAGNOSIS.—Dorsal rays X,11; anal rays III,6; pectoral rays i,6,vii; lateral-line scales 45 to 49; 5 rows of large scales between lateral line and spinous portion of dorsal fin; 11 large scales below lateral line to origin of anal fin; gill rakers 5 or 6+1+10 to 12 (28 specimens, Gilbert Islands, Mauritius, Formosa, and French Oceania).

Snout almost entirely scaled; depth of body 2.6 to 2.8 in standard length; width of body about 2.2 in depth; upper two-fifths of free margin of preopercle very finely serrate; a slight concavity in margin of preopercle just below upper serrate portion; ninth and tenth dorsal spines nearly equal; small scales on cheek do not isolate rows of large scales or individual large scales from one another.

Color in alcohol light brown, with a broad dark brown band along the back, the lower edge of which approximately coincides with lateral line; entire head, nape, pectoral base, and chest with small black spots. The usual color in life pale yellow dorsally and on sides, abruptly pale pinkish tan ventrally, with a broad dark band from eye to base of caudal fin dividing the yellow area of the back into narrow upper and broad lower bands; dark band begins on head as reddish brown or purplish and becomes dark brown or black on posterior two-thirds of body; numerous dark reddish-brown spots over head and anterior part of body; dorsal, caudal, and pectoral fins pink; anal and pelvic fins yellowish. On some specimens the dark band is obscure. Specimens occasionally have a series of large cojoined black spots on the posterior two-thirds of the body as portrayed by Bleeker (1876–77, pl. 149, fig. 5) instead of a uniform lengthwise band. A 58 mm. specimen collected by the author in Moorea was entirely white on the head and body below the dark band. The spots on the head were small and bright red except for those on the lighter anterior portion of the dark band which were black.

REMARKS.—One of the more abundant and widespread of the cirrhitids, *P. forsteri* is known from east Africa to Polynesia. This species has been collected by the author in the Hawaiian Islands, Gilbert Islands, Society Islands, and the Marquesas. In addition to these localities, specimens were examined in the U.S. National Museum from the Philippines, Formosa (collected by R. E. Kuntz), Ryukyu Islands, Fiji, Solomon Islands and New Hebrides (collected by W. M. Chapman), Palau Islands (collected by E. Clark), and Marshall Islands. The Museum of Comparative Zoology at Harvard University has specimens from the Red Sea and Mauritius. The largest specimen examined is 172 mm. in standard length, from Hawaii.

The type of *P. forsteri* was not located. Günther has given a brief description of the osteology of this species.

***Paracirrhites typee*, new species**

FIGURE 10

HOLOTYPE.—MNHN 2908, 157.5 mm. in standard length, Nuku Hiva, Marquesas Islands, *Zélée* expedition, under command of Dumont d'Urville; probable collector, H. Jacquinot, late August-early September, 1838.

DESCRIPTION.—Dorsal rays X,11; anal rays III,6; pectoral rays i,6,vii, lateral-line scales 49 (48); 5 rows of large scales between lateral line and spinous portion of dorsal fin; 10 scales below lateral line to origin of anal fin; gill rakers 6+1+11.

Each of the following measurements is given as a percentage of the standard length: greatest depth of body 34.3; width of body at gill opening 15.7; head length 34.1; snout length 12.1; eye diameter 5.6; postorbital length of head 18.8; bony interorbital space 5.7; least depth of caudal peduncle 13.3; length of caudal peduncle 14.9; snout to origin of dorsal fin 37.7; snout to origin of anal fin 67.8; snout to origin of pelvic fin 43.4; length of dorsal fin base 54.7; length of anal fin base 16.9; length of pectoral fin 17.5; length of pelvic fin 18.2; length of pelvic spine 10.2; length of first dorsal spine 6.4; length of longest (fifth and sixth) dorsal spines 11.9; length of ninth dorsal spine 8.0; length of tenth dorsal spine 8.3; tips of dorsal soft rays broken; length of first anal spine 7.8; length of second anal spine 12.7; length of third anal spine 10.8; tips of anal soft rays broken; ends of caudal rays broken (longest existing rays 19.1 percent of standard length).

In addition to those of the family and genus, the following characters apply to this species: interorbital slightly concave, fully scaled; snout entirely scaled except for narrow region just above upper lip; 5 straight rows of large scales on cheek; small scales surround large scales on cheek separating the rows and isolating adjacent scales within rows (possibly this character will not hold in smaller specimens); 6 large scales on opercle with small basal scales; region of large scales on opercle surrounded by small scales; small scales on free fold of gill membranes that passes over isthmus; interopercle covered with small scales; 10 rows of scales above lateral line on caudal peduncle on one side to lateral line on other; about 11 median predorsal scales; small scales basally on fins; maxillary extends to a vertical at center of eye; upper two-fifths of free margin of preopercle finely serrate (about 43 serrations); a slight concavity in free margin of preopercle just below serrate portion; pelvic fin tips not reaching anus; tenth dorsal spine

only slightly longer than ninth spine; third of lower 7 unbranched pectoral rays the longest; shape of caudal fin, though unknown because of broken tips, probably truncate or slightly rounded; hind flap on anterior nostril with about 18 cirri.

Color in alcohol brown, with 9 irregular slightly diagonal dark brown bars, the first on nape and the last at base of caudal fin; faint longitudinal pale lines following centers of scale rows, these most evident below lateral line (lines appear to be formed by white connective tissue beneath a scale at the juncture of the two scales that it overlaps); fins light brown. Life color unknown.

Remarks.—This species is morphologically similar to *P. forsteri* and *P. hemistictus* (see Key), but very different in color.

It is apparently known only from the holotype which was collected in Nuku Hiva by the *Zélée* expedition in 1838. During a brief stay in the Marquesas Islands, the author noted that this island group, although possessing essentially an impoverished Indo-Pacific fish fauna, appears to have a moderate number of endemic species; however, these species do not approach in magnitude the endemism of the shore fishes of the Hawaiian Islands. *P. typee* may prove to be an example of one of these indigenous forms.

Paracirrhites hemistictus (Günther)

Figures 11, 12

Cirrhites hemistictus Günther, 1874, Fische der Südsee, vol. 1, pt. 3, p. 69, pl. 50, B (type locality, Raiatea, Society Islands).

Cirrhites polystictus Günther, 1874, Fische der Südsee, vol. 1, pt. 3, p. 70, pl. 50, A (Society Islands).

Amblycirrhitus hemistictus Marshall, 1950, Bull. Raffles Mus., no. 22, p. 183, pl. 18 (Cocos-Keeling Islands, Indian Ocean).

Paracirrhites species one. Harry, 1953, Atoll Res. Bull. 18, p. 88 (Raroia, Tuamotus).

Paracirrhites hemistictus Schultz, *in* Schultz and collaborators, 1960, U.S. Nat. Mus. Bull. 202, vol. 2, p. 265, pls. 106,E and 111,C (Bikini Atoll, Marshall Islands).

Diagnosis.—Dorsal rays X,11; anal rays III,6; pectoral rays i,6,vii; lateral-line scales 48 to 51; 5 rows of large scales between lateral line and spinous portion of dorsal fin; 11 scales below lateral line to origin of anal fin; gill rakers 6 or 7+1+11 to 13 (9 specimens, Gilbert, Society, and Tuamotu Islands).

Snout almost entirely scaled; depth of body 2.8 to 3.2 in standard length; width of body 1.9 to 2.2 in depth (width relatively greater in larger specimens); upper two-fifths of free margin of preopercle finely serrate; a slight concavity in margin of preopercle just below serrate

portion; tenth dorsal spine noticeably longer than ninth spine; small scales on cheek do not isolate rows of large scales or individual large scales from one another.

Color in alcohol either light brown, with a median lateral lengthwise pale band and numerous dark brown spots on back, or brown, with numerous brown spots on body and a white spot about the size of the eye in the middle of the body on the lateral line.

REMARKS.—Marshall (1950) reported on a single specimen 142 mm. in standard length from Cocos-Keeling which was intermediate in color pattern to the 2 nominal species *Paracirrhites hemistictus* and *P. polystictus*. This led him to a comparison of the 2 Günther types and the decision that these fishes represent a single species, *hemistictus*. Three immature specimens, 74 to 78 mm. in standard length, collected by the author in Makatea, Tuamotu Archipelago, are also intermediate in color pattern to *hemistictus* and *polystictus*, having both the pale band of the former and the pale spot of the latter.

Schultz (Schultz and collaborators, 1960) sexed 3 specimens of *hemistictus* and the 2 of *polystictus* and concluded that *polystictus* is the male of *hemistictus*. Additional determinations now reveal that the 2 color patterns are not correlated with sex. Three specimens of the *polystictus* form from 166 to 190 mm. in standard length are females, and 2 specimens of *hemistictus* 170 and 195 mm. in standard length are males.

Although these 2 forms are here treated as a single dichromatic species, the possibility that they are valid species and the intermediates are hybrids, as suggested by the author (1955, p. 198), should be investigated.

The color from a 35-mm. kodachrome taken of a 185-mm. specimen of the *hemistictus* form collected by the author at Arno Atoll in the Marshall Islands is: upper half of body grayish green, lower half greenish white, these two regions separated by a pinkish-white band; upper green part of body densely spotted with black; brownish yellow spots just beneath white band; more ventrally, lengthwise rows of yellow spots; head gray; dorsal fin dusky yellow; caudal and anal fins yellow; paired fins yellow-orange.

Color from a kodachrome of a 190-mm. specimen of the *polystictus* form from Onotoa, Gilbert Islands: head brownish lavender-red, body bluish gray with numerous close-set dark brown spots, those on ventral part of body not as large and forming lengthwise lines; a prominent bright pinkish white spot, almost as large as eye, on lateral line below base of eighth and ninth dorsal spines; median and pelvic fins dark grayish brown, the spinous portion of the dorsal fin with faint brownish orange spots; pectoral fins lavender-red proximally, bright orange distally.

The type of *hemistictus* (No. 1874.11.2.5), a specimen 153.5 mm. in standard length, from Raiatea, is in the British Museum.

This species is known in the tropical Pacific from Guam (Fowler, 1925), Phoenix Islands (Schultz, 1943), Society, Tuamotu, Gilbert, and Marshall Islands, and from one locality in the Indian Ocean, Cocos-Keeling Islands. Further collecting will probably dispel the present discontinuities in its range. Apparently the largest species of the genus; both forms are known to attain at least 190 mm. in standard length.

Two specimens at the Museum of Comparative Zoology are labelled as collected by Garrett in the Hawaiian Islands. This locality is probably an error, for Günther did not list any Garrett specimens from Hawaii, and the species has not turned up in other extensive collections from this archipelago.

Paracirrhites arcatus (Cuvier)

FIGURE 13

Cirrhites arcatus Cuvier, *in* Cuvier and Valenciennes, 1829, Histoire naturelle des poissons, vol. 3, p. 74 (type locality, Mauritius and Tahiti).

Cirrhites vittatus Cuvier, 1829, Le régne animal . . ., vol. 2, p. 146 (after Renard pl. 18, fig. 102).

DIAGNOSIS.—Dorsal rays X,11; anal rays III,6; pectoral rays ii,5,vii or ii,6,vi (usually with lower 7 rays unbranched) lateral-line scales 45 to 50 (see table 2); 5 rows of large scales between lateral line and spinous portion of dorsal fin; 11 large scales below lateral line to origin of anal fin; gill rakers 4 or 5+1+11 or 12 (20 specimens, Society and Tuamotu Islands).

TABLE 2.—*Lateral-line scales of species of* Paracirrhites *of the* arcatus *complex*

	45	46	47	48	49	50	51	52
P. arcatus (by color):								
Normal color with pale band	2	10	35	36	23	2	–	–
Melanistic without pale band	1	2	7	5	5	1	–	–
P. arcatus (by locality):								
Mauritius	–	–	1	1	–	–	–	–
Maldive Islands	–	–	–	1	1	–	–	–
Fiji	–	1	1	–	–	–	–	–
Samoa Islands	1	1	13	6	9	–	–	–
Gilbert Islands	–	1	–	3	1	–	–	–
Marshall Islands	–	5	18	13	9	1	–	–
Hawaiian Islands and Johnston Island	2	2	2	5	4	1	–	–
Society and Tuamotu Islands	–	2	7	12	4	1	–	–
P. zosthus	–	–	–	–	1	6	1	1
P. nisus	–	–	–	1	1	–	–	–
P. bicolor	–	–	–	1	–	–	[1]1	–

[1] 50 lateral-line scales on one side, 52 on other.

No scales on snout anterior to nostrils; depth of body about 2.6 in standard length; width of body about 2.7 in depth; upper margin of preopercle smooth; no concavity in preopercular margin; caudal fin truncate to slightly rounded.

The usual color in alcohol is brown with a pale lengthwise band which begins beneath spinous portion of the dorsal fin and follows the lateral line to the upper base of the caudal fin; a diagonal U-shaped mark behind eye; 2 to 4 dark-edged pale transverse bands (which may be broken into 2 or more elongate spots) on interopercle.

Color in life of specimens collected by the author in the Tuamotus: light grayish brown, the centers of the scales a little paler than edges, resulting in a faint lengthwise banding; a broad lengthwise pale pink to white band running over region of lateral line from beneath base of about the seventh dorsal spine to caudal fin; a large U-shaped area, only slightly darker than rest of head and enclosed by a tricolored border of bright orange, dark brown, and outwardly light blue, extending diagonally upward from rear of eye; three bright orange bands cross interopercle, the uppermost at edge of opercle, these bands narrowly edged with dark brown and broadly with pale blue; anterior nostril, tips of snout above upper lip, front edge of lower lip, maxillary and premaxillary groove bright orange; fins light yellowish brown.

REMARKS.—Occasional specimens of *arcatus*, which may be either male or female, are dark brown and lack the lengthwise pale band on the body. Günther (1874, p. 70, pl. 49, B, C) illustrated both forms and regarded them as color varieties. Specimens intermediate in color have been examined, and no meristic differences between the two forms were ascertained (see table 2 for comparison of lateral-line scale counts); Günther's judgment, therefore, seems correct.

A syntype of *arcatus* from Mauritius (MNHN 2854) measures 82 mm. in standard length and is well preserved; it is here designated as the lectotype, and the type locality is thus restricted to Mauritius.

This Indo-Pacific species is at least as widespread and abundant as *P. forsteri*. Largest specimen examined, 111 mm. in standard length, from Hawaii.

Paracirrhites amblycephalus (Bleeker)

FIGURE 14

Cirrhites amblycephalus Bleeker, 1857, Natuurk. Tijdschr. Nederlandsch-Indië, vol. 13, p. 378 (type locality, Sangi Islands).

Paracirrhites amblycephalus Bleeker, 1876–77, Atlas ichthyologique . . . , vol. 8, pp. 143, 145, pl. 350, fig. 1.

DIAGNOSIS.—Dorsal rays X,11; anal rays III,6; pectoral rays ii,5,vii; lateral-line scales 48; 5 rows of large scales between lateral line and spinous portion of dorsal fin; caudal fin strongly rounded;

depth of body about 2.6 in standard length (3¼ in total length); preopercular margin serrate, rounded, without a concavity.

Color of body orange-red with 16 to 18 brownish longitudinal streaks, one on each scale row; a U-shaped dark brown mark wider than pupil of eye and edged with orange extending diagonally upward from posterior upper half of eye (after Bleeker).

Remarks.—Known only from the Sangi Islands, between Celebes and Mindanao. This species has erroneously been placed in the synonymy of *arcatus* by some authors, probably because of its similar postocular mark.

Bleeker described a median crest on the head of *amblycephalus*, although there is no evidence of this from his figure. M. Boeseman examined the type (No. 5841), evidently the only known specimen, at the Rijksmuseum van Natuurlijke Historie at Leiden. He reported the specimen, about 78 mm. in standard length, to be in poor condition. The upper part of the head has been skeletonized, and the median crest appears to be only the bony ridge of the supraoccipital exposed by the removal of soft tissue. It was hoped that the position and shape of the postocular mark and the shape of the caudal fin, as described and figured by Bleeker, could be verified; however, the postorbital part of the head is badly damaged and no color markings are visible. The caudal fin is mutilated.

Paracirrhites xanthus, new species

Figure 15

Holotype.—USNM 190568, a male specimen, 104.0 mm. in standard length, Takapoto Atoll, Tuamotu Archipelago, southeast side of atoll off village on sea side, depth about 25 feet, spear, J. Randall, Nov. 19, 1956.

Paratypes.—USNM 190569, 94.5 mm. in standard length, same collecting data as holotype; SU 54224, 80.4 mm. in standard length, Moorea, Society Islands, 200 yards west of Tareu Pass, depth 15 feet, spear, J. Randall, May 15, 1957; USNM 190570, 2 specimens, 66.7 and 68.0 mm. in standard length, Takaroa Atoll, Tuamotu Archipelago, north side of pass where enters sea, depth 15 feet, spear, J. Randall, Nov. 5, 1956; BM 1960.10.3.1, 69 mm. in standard length, same data as preceding; USNM 190571, 3 specimens, 51.5 to 65.6 mm. in standard length, Caroline Atoll (10°S., 150°14′W.), anchorage on west side outside reef, depth 20 to 30 feet, spear, J. Randall, Feb. 12, 1956.

Description (data in parentheses are the extremes in counts and measurements for paratypes when differing from holotype).—Dorsal rays X,11; anal rays III,6; pectoral rays ii,5,vii; lateral-line scales 50 (49 to 52) (table 2); 5 rows of large scales between lateral line and

spinous portion of dorsal fin; 12 scales below lateral line to origin of anal fin; gill rakers 4+1+12 (4 or 5+1+12 or 13) (9 specimens).

Each of the following measurements is given as a percentage of the standard length; measurements of paratypes are based on 4 specimens, 94.5, 80.4, 66.7, and 51.5 mm. in standard length: greatest depth of body 38.9 (38.1 to 39.9); width of body at gill opening 16.8 (14.8 to 16.9); head length 37.0 (36.5 to 39.1); snout length 12.0 (10.6 to 13.0); eye diameter 7.2 (7.4 to 9.7); postorbital length of head 20.6 (19.3 to 22.2); bony interorbital space 5.3 (5.1 to 5.4); least depth of caudal peduncle 13.0 (13.2 to 14.2); length of caudal peduncle 14.5 (14.0 to 15.2); snout to origin of dorsal fin 40.1 (38.6 to 40.5); snout to origin of anal fin 66.4 (65.8 to 69.8); snout to origin of pelvic fin 44.2 (43.0 to 47.3); length of dorsal fin base 53.8 (52.0 to 54.0); length of anal fin base 18.0 (18.5 to 18.9); length of pectoral fin 22.1 (22.5 to 24.9); length of pelvic fin 18.5 (20.1 to 22.2); length of pelvic spine 11.3 (11.7 to 11.8); length of first dorsal spine 5.5 (5.8 to 6.3); length of third (longest) dorsal spine 12.1 (12.6 to 14.5); length of tenth dorsal spine 8.6 (8.4 to 8.6); length of first dorsal soft ray 18.5 (18.0 to 19.4); length of last dorsal ray 10.7 (11.2 to 12.0); length of first anal spine 8.4 (8.7 to 9.7); length of second anal spine 12.3 (13.6 to 16.5); length of third anal spine 11.7 (12.8 to 14.9); length of first anal soft ray 17.8 (18.2 to 20.6); length of last anal ray 13.5 (14.7 to 15.6); length of caudal fin 20.1 (20.7 to 24.1).

In addition to those of the family and genus, the following characters apply to this species: interorbital slightly concave with a median band of small scales about one-half total width of bony interorbital space; small scales middorsally on snout extend forward to anterior nostrils; a few small embedded scales on preorbital; 6 straight rows of large scales on cheek; large scales on cheek and opercle with small basal scales; large-scaled areas on cheek and opercle bordered by small scales; interopercle covered with small scales; 10 rows of scales above lateral line on caudal peduncle on one side to lateral line on other; about 12 median predorsal scales; small scales basally on fins; maxillary extending to or beyond a vertical through hind edge of pupil; upper middle part of free margin of preopercle with a few tiny serrations; margin of preopercle rounded with no marked concave indentation; pelvic fin tips reach to or slightly beyond anus, but not to origin of anal fin; first dorsal ray slightly extended; second and third of the lower 7 unbranched pectoral rays the longest; caudal fin truncate; hind flap on anterior nostril with about 9 to 17 cirri (17 on holotype).

Color in alcohol light yellowish brown, a little darker dorsally, some specimens with about 3 broad bars faintly visible on back; a pale-edged, slightly irregular black mark about as long as eye extending diagonally upward from rear center of eye; fins pale yellowish, the posterior part

of the upper and lower edges of the caudal fin with a very narrow black margin; on some specimens a dusky streak on membranes in soft portion of dorsal fin just above basal scales; no spots or bands on snout, maxillary, or interopercle.

Life color of holotype bright yellow, the back brownish yellow, with a narrow black postocular mark edged narrowly in pale yellow extending diagonally upward from hind part of eye; spinous portion of dorsal fin yellow, soft portion yellow on basal two-fifths and hyaline with yellow rays on outer three-fifths; remaining fins hyaline with yellow rays except basal scaled portions which are solid yellow; iris yellow with a ring of red-violet. Close inspection of the yellow of the side of the body reveals alternate lines of bright yellow and yellowish white with a faint bluish cast. The overall effect, as when observed underwater, is of an entirely bright yellow fish with a black mark behind the eye. All paratypes were yellow.

REMARKS.—Named *xanthus* in reference to the life color.

Unlike other cirrhitids which are often not seen until they move from part of the reef to another, this bright yellow hawkfish is very conspicuous as it rests on the bottom—usually on a small head of brownish or pinkish *Pocillopora*. Individual fish could be approached closely. When an attempt was made to capture one and it escaped, it would either swim to a nearby coral head or hide within cracks in the coral on which it was encountered.

The species was common at Caroline Atoll, occasional in the Tuamotu Archipelago, and rare in the Society Islands. It was observed only on exposed outer reefs at depths of less than 10 to 80 feet.

Paracirrhites xanthus is closely related to the East Indian *P. amblycephalus* (Bleeker). The rounded caudal fin, shape and position of the postocular mark, and orange-red color attributed to *amblycephalus* by Bleeker constitute the principal differences from *xanthus*. The type of *amblycephalus* is badly damaged, and the differences can no longer be demonstrated (see "Remarks" under *amblycephalus*); thus the distinction of these 2 species draws heavily on Bleeker's figure and description.

Paracirrhites nisus, new species

FIGURE 16

HOLOTYPE.—USNM 190572, a ripe female specimen, 77.0 mm. in standard length, Takapoto Atoll, Tuamotu Archipelago, southeast side of atoll off village on sea side; depth about 25 feet, spear, J. Randall, Nov. 19, 1956.

PARATYPE.—USNM 190573, a male specimen, 51.5 mm. in standard length, same collecting data as holotype.

DESCRIPTION (data in parentheses are the counts and measurements of the paratype when differing from holotype).—Dorsal rays X,11; anal rays III,6; pectoral rays ii,5,vii; lateral-line scales 48 (49); 5 rows of large scales between lateral line and spinous portion of dorsal fin; 11 scales below lateral line to origin of anal fin; gill rakers 4+1+11.

Each of the following measurements is given as a percentage of the standard length: greatest depth of body 38.3 (36.8); width of body at gill opening 17.0 (15.3); head length 39.4 (39.1); snout length 11.6 (11.2); diameter of eye 8.3 (9.5); postorbital length of head 21.8 (21.5); bony interorbital space 5.5 (5.4); least depth of caudal peduncle 13.6; length of caudal peduncle 14.5 (14.6); snout to origin of dorsal fin 41.7 (42.1); snout to origin of anal fin 67.5 (65.2); snout to origin of pelvic fin 44.2 (45.5); length of dorsal fin base 53.5 (51.5); length of anal fin base 18.2 (18.5); length of pectoral fin 23.7 (24.3); length of pelvic fin 20.6 (20.4); length of pelvic spine 12.9 (13.6); length of first dorsal spine 7.8 (7.7); length of third and fourth (longest) spines 13.7 (13.8); length of tenth dorsal spine 9.1 (9.7); length of first dorsal soft ray 18.5 (19.4); length of last dorsal ray 11.4 (11.6); length of first anal spine 8.2 (9.7); length of second anal spine 13.0 (15.1); length of third anal spine 11.6 (12.6); length of first anal soft ray 16.3 (19.0); length of last anal ray 13.7 (13.8); length of caudal fin 21.4 (22.4).

In addition to those of the family and genus, the following characters apply to this species: interorbital slightly concave with a median band of small scales about one-half total width of bony interorbital space; small scales middorsally on snout extend forward almost to anterior nostrils; a few small scales on preorbital; 6 straight rows of large scales on cheek; large scales on cheek and opercle with small basal scales; large-scaled areas on cheek and opercle bordered by small scales; interopercle covered with small scales; 10 rows of scales above lateral line on caudal peduncle on one side to lateral line on other; about 11 median predorsal scales; small scales basally on fins; maxillary extending to or beyond a vertical through hind edge of pupil; upper margin of preopercle smooth or with only a few tiny serrations; margin of preopercle rounded, with no marked concave indentation; tips of pelvic fins reaching anus (holotype) or extending beyond anus; first dorsal soft ray only slightly longer than second; third of lower 7 unbranched pectoral rays the longest; caudal fin truncate; hind flap on anterior nostril with 13 cirri (8 on paratype).

Color in alcohol light brown with a pale lengthwise band, containing posterior portion of lateral line, beginning at level of last dorsal spine and ending in middle of caudal fin; pale band broadly bordered with black except anteriorly (and posteriorly on paratype); an elon-

gate black mark extending diagonally upward from middle of posterior edge of eye, this mark bordered with a pale, dark-margined band which continues along ventral edge of eye and ends on preorbital; anterior nostrils enclosed in a dark-rimmed white spot; upper edge of eye black with 2 white spots; a pair of small white spots, edged in dark brown, anteriorly on snout next to upper lip; a few small blackish streaks on maxillary (one on paratype); spinous portion of dorsal fin and outer part of anal fin slightly dusky; remaining fins pale except dark borders of pale band which extend into center of caudal and the posterior branch and base of the last dorsal ray which are black.

Color in life of holotype: back dusky brown, shading on sides and ventrally to alternate bands of yellow and pale grayish blue; a pinkish white horizontal band on posterior half of body broadly bordered with black except anteriorly, these black borders extending on to middle of caudal fin; an elongate irregular black mark extending diagonally upward from hind edge of eye, this mark narrowly bordered by bright yellow, a trace of red, a narrow black, and finally a narrow bright blue line; multicolored lower border of black mark extends along lower edge of eye almost to upper lip; small blotches of yellow, bordered narrowly with red, black, and bright blue lines on maxillary, tip of snout, anterior nostrils, and dorsal part of eye; spinous portion of dorsal fin dull orange-yellow with a yellow line in outer part of fin; soft portion of dorsal fin hyaline with orange-yellow rays except rear base and posterior ray which are black, this black continuous with upper black border of pinkish white band on body; anal and pelvic fins yellow; caudal fin posterior to pinkish white, black-bordered marking hyaline with orange-yellow rays; pectoral fins orange-yellow; cheeks and opercle dull yellow; lips and chin reddish.

Remarks.—Named *nisus* from the Greek *Nisos*, a fabled king said to have been changed into a hawk.

A juvenile was observed underwater at the locality on the outer reef of Takapoto where the only 2 specimens were collected. It was about 25 mm. long and was colored like the larger fish. A single adult was sighted outside the barrier reef at the atoll of Takaroa in the Tuamotu Archipelago at a depth of 45 feet.

***Paracirrhites bicolor*, new species**

Figure 17

Holotype.—USNM 190574, a ripe female specimen, 73.5 mm. in standard length, Caroline Atoll (10° S., 150° 14′ W.), outer reef, west side of atoll at anchorage, depth about 15 feet, spear, J. Randall, Feb. 12, 1956.

Paratype.—USNM 190575, a male specimen, 60.5 mm. in standard length, same collecting data as holotype.

DESCRIPTION (data in parentheses are the counts and measurements of the paratype when differing from holotype).—Dorsal rays X,11; anal rays III,6; pectoral rays ii,5,vii; lateral-line scales 48 (50 on one side, 52 on other); 5 rows of large scales between lateral line and spinous portion of dorsal fin; 12 scales below lateral line to origin of anal fin; gill rakers 4+1+12 (5+1+13).

Each of the following measurements is given as a percentage of the standard length: greatest depth of body 38.1 (40.2); width of body at gill opening 17.4 (16.2); head length 37.7 (37.8); snout length 11.1 (10.2); eye diameter 8.6 (8.8); postorbital length of head 20.5 (20.7); bony interorbital space 5.6 (5.8); least depth of caudal peduncle 12.9 (13.2); length of caudal peduncle 15.1 (14.9); snout to origin of dorsal fin 40.7 (40.5); snout to origin of anal fin 69.5 (70.2); snout to origin of pelvic fin 45.7 (42.0); length of dorsal fin base 53.5 (51.3); length of anal fin base 18.1 (19.0); length of pectoral fin 24.1 (23.1); length of pelvic fin 20.4 (20.6); length of pelvic spine 12.9 (13.5); length of first dorsal spine 6.8 (7.1); length of third (longest) dorsal spine 14.7 (14.5); length of tenth dorsal spine 8.8 (7.1); length of first dorsal soft ray 17.9 (18.1); length of last dorsal ray 11.0 (11.2); length of first anal spine 8.9 (8.7); length of second anal spine 15.2 (14.7); length of third anal spine 12.9 (12.4); length of first anal soft ray 18.8 (18.3); length of last anal ray 13.3 (14.0); length of caudal fin 21.1 (21.0).

In addition to those of the family and genus, the following characters apply to this species: interorbital slightly concave with a median band of small scales about one-half to two-thirds the total width of bony interorbital space; small scales middorsally on snout extend forward to anterior nostrils; preorbital scaled, especially posteriorly; a small patch of scales on side of snout just below and slightly anterior to anterior nostril; 6 straight rows of large scales on cheek; large scales on cheek and opercle with small basal scales; large-scaled areas on cheek and opercle bordered by small scales; interopercle covered with small scales; 10 to 11 rows of scales above lateral line on caudal peduncle on one side to lateral line on other; about 11 median predorsal scales; small scales basally on fins; maxillary reaching past center of eye but not posterior to a vertical at hind edge of pupil; about upper two-fifths of free margin of preopercle finely serrate; preopercular margin rounded with no concave indentation; pelvic fin tips reaching anus; first dorsal soft ray very slightly longer than second; third of the lower 7 unbranched pectoral rays the longest; caudal fin truncate; hind flap on anterior nostril with 10 cirri.

Color in alcohol dark brown, the caudal peduncle and ventral part of abdomen and body just above base of anal fin pale yellowish (brown

body color of paratype extends to base of anal fin); a black mark nearly as long as eye and about equal in width to the diameter of pupil extending diagonally upward from midposterior edge of eye, this mark bordered with a bicolored band which is pale inwardly and black outwardly, the band extending along lower edge of eye half way to upper lip; anterior nostrils in a dark-edged pale blotch, the flap pale, the cirri dark brown; an elongate pale spot on maxillary; 2 small pale spots anteriorly on snout next to upper lip; upper edge of eye black; spinous portion of dorsal fin brownish, soft portion dark brown on basal scaled part, rays light yellowish, membranes with a pale yellowish band just above scaled basal part, this separated by a dark line (better seen on paratype) from upper hyaline part of fin membranes; caudal fin pale yellowish like caudal peduncle except for very narrow black margins on upper and lower edges of fin; anal fin brownish, almost as dark as spinous portion of dorsal fin; pectoral fins brown basally and in middle of fin, becoming pale yellowish outwardly; pelvic fins brownish with pale yellowish rays, the lateral edge of fins dark brown. Life colors not recorded.

REMARKS.—Named *bicolor* in reference to the contrasting dark anterior and pale posterior parts of the body.

Of the 5 species of *Paracirrhites* with postocular marks, which might be termed the *arcatus* complex, *bicolor* seems most closely related to *nisus*.

Genus *Cirrhitops* Smith

Cirrhitops Smith, 1951, Ann. Mag. Nat. Hist., ser. 12, vol. 4, pp. 627, 637. (Type species, *Cirrhites fasciatus* Bennett, by original designation.)

DIAGNOSIS.—Uppermost 2 and lower 6 pectoral rays unbranched; dorsal soft rays 14 (rarely 15); a few small teeth anteriorly on palatines; upper three-fifths of free margin of preopercle finely serrate, lower two-fifths smooth; preorbital without a free hind edge; interorbital not scaled; 5 rows of large scales on cheek; 4 rows of large scales above lateral line in middle of body; depth of body about 2.8 in standard length; snout length about 3.5 in head length; snout not pointed, profile from interorbital to upper lip convex; a tuft of cirri from membrane near tip of each dorsal spine; membranes between spinous portion of dorsal fin moderately incised, the one between fifth and sixth spines notched about one-third of spine lengths; longest dorsal spine about 2.3 in depth of body; first dorsal soft ray not produced; longest pectoral ray (tenth) reaching to or slightly beyond origin of anal fin, this ray about 1.5 times longer than longest branched ray of fin; uppermost simple pectoral ray (ninth) intermediate in length to lowermost branched ray (eighth) and longest unbranched ray; pelvic fins reach anus; caudal fin truncate.

Key to the Species of *Cirrhitops*

1a. Body with 5 vertical dark bars, the most posterior one the darkest; no dark lines on lips (Hawaii, Japan, Madagascar, and Mauritius) . . . **fasciatus**

1b. Body without vertical bars, having instead 4 lengthwise rows of pale spots (the upper 2 rows being more evident because of darker upper half of body) and a pale caudal peduncle containing a large black spot; lips crossed with brown lines (Phoenix Islands and Tuamotu Archipelago) . . . **hubbardi**

Cirrhitops fasciatus (Bennett)

FIGURE 18

Cirrhites fasciatus Bennett, 1828, Zool. Journ., vol. 4, p. 39 (type locality, Hawaiian Islands).

Cirrhites cinctus Günther, 1860, Catalogue . . . fishes . . . British Museum, vol. 2, p. 73 (type locality, Hawaiian Islands, Madagascar, Mauritius).

DIAGNOSIS.—Dorsal rays X,14 (one with 15); anal rays III,6; pectoral rays ii,6,vi; lateral-line scales 48 to 53; 4 large scales above lateral line in middle of body; 11 or 12 large scales below lateral line to origin of anal fin; gill rakers 4+1+12 (10 specimens, Hawaii).

Color in alcohol: alternate broad dark-brown and narrow pale bars on the body, the pale bars divided ventrally by narrow dark bars; broad dark bars vertical anteriorly, slanted posteriorly; last dark bar (fifth) on caudal peduncle the darkest; a dark spot on opercle; head and chest with a reticulation of dark lines.

Life color from kodachromes of 3 Hawaiian specimens (60 to 75 mm. standard length) taken by the author: body with 5 broad red or reddish-brown bars (the last across caudal peduncle the darkest) which narrow and angle slightly posteriorly as they pass downward; white interspaces between these bars bisected ventrally by narrow brownish-red bars; head and chest with orange-red to reddish-brown vermiculations on white; an indistinct brown spot on opercle at level of lower edge of eye formed by a coalescing and darkening of head markings; dorsal fin mottled red, penetrated basally by continuations of white spaces between dark bars on body; caudal peduncle and fin posterior to dark bar light red; anal and paired fins pale (pinkish in darker specimens).

REMARKS.—USNM specimens from the Hawaiian Islands and Yokohama, Japan, were examined. Günther (1860) recorded the species (as *cinctus*) from Madagascar and Mauritius, thus giving the species a unique distribution at the present time. Specimens may eventually be taken at intervening localities between Japan and the western Indian Ocean, such as the Philippines and East Indies. Fowler (1927) recorded a specimen which he identified as *cinctus* from Christmas Island, Line Islands; however, this fish proved to be *Cirrhitichthys oxycephalus* Bleeker.

Cirrhitops hubbardi (Schultz)

FIGURE 19

Amblycirrhitus hubbardi Schultz, 1943, U.S. Nat. Mus. Bull. 180, p. 132, fig. 12 (type locality, Enderbury Island, Phoenix Islands).

DIAGNOSIS.—Dorsal rays X,14; anal rays III,6; pectoral rays ii,6,vi; lateral-line scales 52; 4 rows of large scales above lateral line in middle of body; 11 or 12 scales below lateral line to origin of anal fin; gill rakers 4 to 5+1+12 or 13 (4 specimens).

Color in alcohol brown shading to light tan on lower half of body, with 4 rows of white spots on the side and a large jet-black spot on caudal peduncle; a blackish area on opercle composed of several irregular black markings; vertical dark lines on lips; irregular small dark spots and lines on head and chest.

Color from a 35 mm. kodachrome transparency taken of a specimen 70 mm. in standard length from Makatea in the Tuamotus by the author: body brown on back, shading on sides to brownish orange, and becoming white on abdomen; 4 lengthwise rows of white spots on body; caudal peduncle light orange with a large black spot; head and chest with irregular rows of small spots and short lines, those on dorsal part of head brown and those ventral to eye bright red; a group of spots and irregular short lines on opercle at level of lower edge of eye darker than other head markings; dorsal fin mottled with red; caudal fin light red, abruptly light orange at base; anal fin pale; paired fins pinkish.

REMARKS.—Smith (1951, p. 637) placed *hubbardi* in the synonymy of *cinctus* (=*fasciatus*), stating that it is almost certainly the juvenile of *fasciatus*. Although these 2 species are obviously very closely related, they do appear distinct. The color pattern of *hubbardi* is definitely not the juvenile color of *fasciatus*. W. A. Gosline kindly checked specimens of *fasciatus* in the collection of the University of Hawaii down to 26 mm. in standard length and reported them looking "pretty much like the larger ones."

C. hubbardi is presently known only from the 3 small type specimens from the reef of Enderbury Island, the single specimen from the Tuamotu Archipelago, and a specimen in the Academy of Natural Sciences of Philadelphia (No. 84311), 79 mm. in standard length, with no locality but labelled "probably Oceania". The specimen is cataloged as a type; however, Henry W. Fowler informed the author that the name he proposed has not been published.

C. hubbardi and *C. fasciatus*, as mentioned, are closely related. They may represent allopatric species, the former being restricted to Oceania except Hawaii. Further collecting is necessary to verify this.

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The 70-mm. Tuamotu specimen was collected with rotenone on an exposed reef in less than 15 feet of water near the phosphate loading dock of Makatea. *Amblycirrhitus bimacula*, *Isocirrhitus sexfasciatus*, *Cirrhitus pinnulatus*, *Paracirrhites arcatus*, and *P. hemistictus* were collected at the same station.

The holotype (USNM 115750), 35 mm. in standard length, was examined. The 47-mm. paratype is now in the Museum of Comparative Zoology at Harvard University (No. 37288).

Isocirrhitus, new genus

DIAGNOSIS.—Uppermost and lower 5 pectoral rays unbranched; dorsal soft rays 11; palatine teeth absent; upper third of free margin of preopercle finely serrate, lower two-thirds smooth; suprascapular margin smooth (serrate on other genera except for some species of *Cirrhitus*, *Paracirrhites* and *Amblycirrhitus*); preorbital without a free hind margin and bearing only a few scales posteriorly; interorbital scaled; 4 or 5 rows of large scales on cheek; 4 rows of large scales above lateral line in middle of body; depth of body 2.7 in standard length; snout length about 3.7 in head length; snout not pointed, the profile from interorbital to upper lip convex; a tuft of cirri from membrane near tip of each dorsal spine; membranes of dorsal fin moderately incised; longest dorsal spine 3.5 to 4 in body depth; first soft ray of dorsal fin not produced into a filament; pectoral fins short, their length about 1.4 in head length; longest unbranched pectoral ray about 1.25 times longer than longest branched pectoral ray; pelvic fins do not reach anus; caudal fin truncate.

TYPE SPECIES.—*Cirrhitoidea sexfasciata* Schultz. Monotypic.

REMARKS.—Although evidently related to *Cirrhitops*, *Amblycirrhitus* and *Cirrhitichthys*, *Isocirrhitus* is distinct from all these genera in its lack of palatine teeth and the shortness of its dorsal spines. Other characters, such as degree of serration of preopercle, presence or absence of a free margin on preorbital, number of dorsal rays and shape of snout, are variously shared among the four genera. *Isocirrhitus* cannot be differentiated from *Paracirrhites* on the basis of absence of palatine teeth and short dorsal spines; however, it is separable from this genus by having 4 instead of 5 rows of scales above the lateral line, a tuft of cirri instead of a single cirrus from the membrane near the tip of each dorsal spine, and the lower 5 (instead of 7) pectoral rays unbranched. Its unbranched pectoral rays are not as long relative to the branched rays as those of *Cirrhitops*, *Amblycirrhitus* and *Cirrhitichthys* but longer than *Paracirrhites*.

Isocirrhitus sexfasciatus (Schultz)

FIGURE 20

Paracirrhites cinctus Harry, 1953 (non Günther), Atoll Res. Bull. 18, p. 88, (Raroia, Tuamotu Archipelago).

Cirrhitoidea sexfasciata Schultz, *in* Schultz and collaborators, 1960, U.S. Nat. Mus. Bull. 202, vol. 2, pp. 255, 257, fig. 106 (type locality, Bikini Atoll, Marshall Islands).

DIAGNOSIS.—Dorsal rays X,11; anal rays III,6; pectoral rays i,8,v; lateral-line scales 44 or 45; 4 rows of large scales above lateral line in middle of body; 9 scales below lateral line to origin of anal fin; gill rakers 4 or 5+1+11 (3 specimens, Tuamotu Archipelago).

Color light tan with 7 broad blackish vertical bars, the first on the nape and the last at the base of the caudal fin. A drab species for a cirrhitid, its life color is not much different from that in alcohol. Harry (1953) gave a detailed color description. Further characters are given in the generic diagnosis.

REMARKS.—Three specimens, 61 to 70 mm. in standard length, were collected by the author at Makatea in the Tuamotu Archipelago at the same collecting station as the previous species. Known only from the Marshall Islands and the Tuamotu Archipelago, but continued collecting will probably reveal its presence elsewhere in the Indo-Pacific.

The holotype (USNM 141980) is 77.5 mm. in standard length.

Genus *Amblycirrhitus* Gill

Amblycirrhitus Gill, 1862, Proc. Acad. Nat. Sci. Philadelphia, p. 105. (Type species, *Cirrhites fasciatus* Cuvier, by original designation and monotypy = *Amblycirrhitus indicus* Fowler.)

Cirrhitoidea Jenkins, 1903, Bull. U.S. Fish Comm., vol. 22 (1902), p. 489. (Type species, *Cirrhitoidea bimacula* Jenkins, by monotypy.)

Pseudocirrhites Mowbray, *in* Breder, 1927, Bull. Bingham Oceanogr. Coll., vol. 1, p. 48. (Type species, *Pseudocirrhites pinos* Mowbray, by monotypy.)

DIAGNOSIS.—Upper 1 or 2 and lower 5 (rarely 6) pectoral rays unbranched; dorsal soft rays 11 or 12; palatine teeth present; upper margin of preopercle finely serrate; preorbital without a free hind margin; interorbital scaled; 4 or 5 rows of large scales on cheek; 3 or 4 rows of large scales above lateral line in middle of body; depth of body 2.3 to 3.2 in standard length; snout length 3.1 to 3.8 in head length; snout pointed, profile from interorbital to upper lip nearly straight; a tuft of cirri from membrane near tip of each dorsal spine; membranes of dorsal fin moderately to deeply incised, the one between fifth and sixth dorsal spines notched more than three-tenths length of spines; longest dorsal spine 2.3 to 3.2 in body depth; first dorsal soft ray not produced into a filament; pectoral fins moderately

long, extending to anus and usually to origin of anal fin; lower unbranched rays of pectoral fin markedly longer than upper branched rays, the uppermost unbranched ray usually the longest; caudal fin truncate.

Key to the Species of *Amblycirrhitus*

1a. Lateral-line scales 38 to 45; pectoral fins reach or extend beyond origin of anal fin; dorsal soft rays 11 or 12; ocellated black spot on opercle present or absent.

2a. Dorsal soft rays 11; upper ⅓ to ½ of preopercular margin serrate; small pale spots on head, anteriorly on body, and on dorsal fin.

3a. Depth of body 2.3 in standard length; dorsal profile from snout forms an angle of 48° to horizontal; lateral-line scales 45; upper 2 pectoral rays unbranched (based on a single 93 mm. specimen) (India). **indicus**

3b. Depth of body about 2.7 in standard length; dorsal profile from snout forms an angle of about 35° to horizontal; lateral-line scales 41 to 44; upper pectoral ray unbranched (West Indies and Florida). **pinos**

2b. Dorsal soft rays 12; upper ⅗ to ⅔ of preopercular margin serrate; no small pale spots on head, anteriorly on body, or on dorsal fin.

4a. A large dark brown or black ocellated spot on opercle; head not crossed with 3 vertical dark bars; longest dorsal spine about 2.7 in depth of body (Indo-Pacific) . . . . . **bimacula**

4b. No large dark brown or black ocellated spot on opercle; head crossed with 3 vertical dark bars, the first running ventrally from eye, the next 2 on operculum; longest dorsal spine about 2.3 in depth of body (East Indies). . . . . **oxyrhynchos**

1b. Lateral-line scales 48 to 50; pectoral fins do not reach origin of anal fin; dorsal soft rays 11; ocellated black spot on opercle absent (Ryukyu Islands and Formosa) . . . . . **unimacula**

Amblycirrhitus indicus Fowler

FIGURE 21

Cirrhites fasciatus Cuvier, *in* Cuvier and Valenciennes, 1829 (non Bennett), Histoire naturelle des poissons, vol. 3, p. 76, pl. 47 (type locality, Pondichéry, India).

Cirrhitichthys fasciatus Day, 1888, Fishes of India . . . , suppl., p. 788 (Madras); 1889, Fauna of British India, Fishes, vol. 2, p. 145.

Amblycirrhitus indicus Fowler, 1938, Proc. U.S. Nat. Mus., vol. 85, p. 49 (new name for *Cirrhites fasciatus* Cuvier, preoccupied by *C. fasciatus* Bennett, 1828).

DIAGNOSIS.—Dorsal rays X,11; anal rays III,6; pectoral rays ii,7,v; lateral-line scales 45; 4 rows of large scales above lateral line in middle of body (one specimen, Pondichéry).

Depth of body about 2.3 in standard length; dorsal profile from snout forms an angle of 48° with a line from tip of snout to center of caudal fin; longest pectoral rays (tenth and eleventh) nearly reach a vertical through origin of anal fin (from Cuvier's illustration; rays

broken on specimen); pelvic fins reach origin of anal fin; snout about 3.5 in head length.

Color light brown with 8 alternately broad and narrow vertical dark bars on body which narrow as they pass ventrally; bar on caudal peduncle and upper part of preceding bar the darkest; small pale spots on snout, nape, and spinous portion of dorsal fin.

REMARKS.—The holotype (MNHN 5428 A) is a dried half-specimen varnished and mounted on glass. The color pattern is so remarkably close to the West Indian *pinos* that *indicus* was thought to be this species at first glance. There are adequate morphological characters, however, to separate the two. The holotype of *indicus* measures 93 mm. in standard length (which is considerably larger than the largest of many individuals of *pinos* that have been observed). Other measurements from the type are: depth 40.5 mm.; head 32 mm.; snout 9.3 mm.; eye 7 mm.; depth of caudal peduncle 13.5 mm.; caudal fin 13.5 mm.; pelvic fins 24.2 mm.; first dorsal spine 4.7 mm.; second dorsal spine 8.5 mm.; third dorsal spine 12.6 mm.; ninth dorsal spine 10.8 mm.; tenth dorsal spine 14 mm.; first dorsal soft ray 19 mm.; last dorsal soft ray 10.7 mm.; first anal spine 12 mm.; second anal spine 22 mm.; third anal spine 17 mm.; first anal soft ray broken; last anal ray 12 mm.

The type shows some notable differences from Cuvier's plate. The origin of the dorsal fin is not anterior to the hind edge of the preopercle as illustrated, but is in line with a vertical at the hind edge; the caudal fin is longer than illustrated; instead of a single cirrus from the membrane at the tip of each dorsal spine there is a tuft of cirri (congealed to a single unit by the varnish); the preorbital has no free hind edge; there are 27 small serrations on the free margin of the preopercle.

Known only from India from the type and two small specimens reported by Day.

Amblycirrhitus pinos (Mowbray)

FIGURE 22

Pseudocirrhites pinos Mowbray, *in* Breder, 1927, Bull. Bingham Oceanogr. Coll., vol. 1, p. 48, fig. 23 (type locality, Isle of Pines).

Pseudocirrhites pinos Tee-Van, 1940, Zoologica, vol. 25, p. 61, text fig. 3 (Isle of Pines and Saba Bank).

DIAGNOSIS.—Dorsal rays X,11; anal rays III,6; pectoral rays i,8,v; lateral-line scales 41 to 44; 4 rows of large scales between lateral line and spinous portion of dorsal fin (3 rows beneath soft portion of fin); 9 scales below lateral line to origin of anal fin; gill rakers 4 or 5+1+8 to 10 (18 specimens, West Indies and Florida).

Depth of body of adults about 2.7 in standard length; dorsal profile from snout forms an angle of about 35° with a line from tip of snout to center of caudal fin; longest pectoral rays reaching a vertical through base of second to third anal spines; pelvic fins not reaching origin of anal fin; snout of adults about 4 to 4.5 in head length.

Color in alcohol light tan with alternate broad and narrow dark bars on body, the one across caudal peduncle and upper part of previous one at base of soft portion of dorsal fin jet black; small pale spots on head, nape, chest, pectoral base, and spinous portion of dorsal fin.

Color in life: body with 5 broad dark bars, the first 3 yellowish brown, the upper rounded part of the fourth black and the fifth across the caudal peduncle entirely black; white interspaces between first 4 broad bars bisected by narrow yellowish brown bars; head, anterior part of body, and dorsal fin with bright red-orange dots; scaled portion of dorsal fin colored like body, unscaled portion hyaline; red-orange spots on soft portion of fin located on fin rays (fade in preservative); caudal fin pink, becoming white basally; anal and pelvic fins hyaline with light brownish rays; pectoral fins pale pink; iris yellowish.

REMARKS.—Known previously from the Isle of Pines just south of western Cuba and the Saba Bank in the Lesser Antilles. The Saba Bank specimen is a 26-mm. juvenile collected by William Beebe at a depth of 25 fathoms. In recent years the species has been collected by the author in the Virgin Islands, Puerto Rico, Curaçao, Haiti, and the Bahamas, and by Walter A. Starck II and the author at Alligator Reef in the Florida Keys. Starck collected a 23-mm. specimen from Banco Chinchorro, off Yucatan. Collecting depths have been 8 to 120 feet. These specimens are deposited at the Marine Laboratory of the University of Miami and at the University of Puerto Rico, Mayaguez, Puerto Rico. Largest specimen, 68 mm. in standard length, from the Florida Keys.

The holotype (BOC 382) is 54.5 mm. in standard length.

Two specimens collected in August 1955 measure 24.0 and 24.7 mm. in standard length and appear to be transforming from the late postlarval stage to the juvenile form. Although pale, the barred color pattern may be faintly seen, the caudal peduncle and upper part of preceding bar being the darkest. These specimens differ from larger *pinos* in being relatively more elongate (depth 7.5 and 8.1 mm., respectively), in having a forked caudal fin (caudal indentation 3 and 2.5 mm., respectively), and in having the eye nearer the center of the head (separated by more than 0.5 mm. from upper profile of head). A 25-mm. juvenile collected in November 1959 has the typical adult color pattern, a slightly forked tail, a body depth of 9 mm., and the

upper edge of the eye at the profile of the head. A 24-mm. juvenile collected in July 1959 is adultlike in its color and has slightly emarginate caudal fin, body depth of 9.5 mm., and eye which juts slightly above the profile of the head. These 4 specimens were collected in the Bahamas in connection with the ichthyological program of Charles C. G. Chaplin and James E. Böhlke and are deposited in the Academy of Natural Sciences of Philadelphia under Nos. 93637 to 93640.

Amblycirrhitus bimacula (Jenkins)

FIGURE 23

Cirrhitoidea bimacula Jenkins, 1903, Bull. U.S. Fish Comm., vol. 22 (1902), p. 459, fig. 36 (type locality, Honolulu).

DIAGNOSIS.—Dorsal rays X,12; anal rays III,6; pectoral rays i,8,v; lateral-line scales 40 to 42 (only one with 42); 3 large scales above lateral line in middle of body; 9 scales below lateral line to origin of anal fin; gill rakers 3 to 5+1+10 or 11 (12 specimens, Marshall Islands, Johnston Island, and Tuamotu Archipelago).

Longest pectoral ray reaching a vertical through base of second anal spine; depth of body of adults 2.8 to 3 in standard length; origin of dorsal fin slightly anterior to a vertical at hind edge of opercular membrane.

Color in preservative light brown with about 10 slightly irregular brown bars (some of which break into spots on occasional specimens); an ocellated black spot almost as large as eye on opercle slightly below level of eye and another on back and scaled portion of soft dorsal centered at base of ninth soft ray of fin; upper portion of 3 body bars usually cojoin to enclose that portion of ocellated spot on body and base of soft dorsal; head mottled with brown, some specimens with 1 or 2 diagonal brown bands on cheek; tips of spinous dorsal membranes not blackish.

REMARKS.—Jenkins was mistaken in stating that *bimacula* has no palatine teeth. The holotype (USNM 50702), 41 mm. in standard length, was examined, and teeth were found on the palatines.

A. bimacula has an extensive range, east Africa (Smith, 1951) to Hawaii; however, records of the species are not numerous. Intermediate localities from which it has been taken are: Aldabra (Smith, 1955, name only); Comore Islands (Fourmanoir, 1954, name only); Saleyer, East Indies (Weber, 1913; de Beaufort, 1940); Rose Island, Samoa Islands (Schultz, 1943); Raroia, Tuamotu Archipelago (Harry, 1953); and the Marshall Islands (Schultz, *in* Schultz and collaborators, 1960). A specimen, 54.5 mm. in standard length, was recently collected in the Seychelles by James Morrow and deposited in the Bingham Oceanographic Laboratory at Yale University. The author collected one, 51.5 mm. in standard length, at Makatea in the

Tuamotu Archipelago. A 43-mm. specimen from Tahiti and 3 specimens from 43 to 51 mm. in standard length from the Solomon Islands were sent on loan from the British Museum by A. C. Wheeler. Largest specimen examined, 67 mm. in standard length, from Kwajalein.

Amblycirrhitus oxyrhynchos (Bleeker)

FIGURE 24

Cirrhitichthys oxyrhynchos Bleeker, 1858, Natuurk. Tijdschr. Nederlandsch-Indië, vol. 15, p. 205 (type locality, Goram Islands, East Indies).

Cirrhitichthys oxyrhynchus Bleeker, 1876–77, Atlas ichthyologique . . . vol. 8, p. 146, pl. 303, fig. 4.

DIAGNOSIS.—Dorsal rays X,12; anal rays III,6; pectoral rays i,8,v; lateral-line scales 40; 3 rows of large scales above lateral line in middle of body; 10 scales below lateral line to origin of anal fin. Longest pectoral rays reaching a vertical through base of third anal soft ray; depth of body 3.1 in standard length; origin of dorsal fin over hind margin of opercle; lower jaw projects slightly anterior to upper; longest dorsal spine (sixth) 2.3 in depth of body (2.6 to 3.2 for other species of *Amblycirrhitus*).

Color of body and fins rose with 8 near-vertical brown bars or elongate spots on body and 3 bars on head; a round dark brown spot on back at rear base of soft portion of dorsal fin (after Bleeker's description and figure).

REMARKS.—M. Boeseman kindly examined the holotype (No. 5842) at the Rijksmuseum van Natuurlijke Historie at Leiden. He verified Bleeker's fin-ray counts, length shown for the pectoral fin, and slight jutting of the lower jaw. The following measurements were made: standard length 43 mm.; total length 52 mm.; body depth 13.8 mm.; snout length 4.2 mm.; longest dorsal spine 6 mm. The margin of the preopercle above the level of the center of the eye bears 15 small serrations. Color markings are no longer visible on the specimen.

De Beaufort (1940, p. 10) erroneously placed *oxyrhynchos* in the synonymy of *Cirrhitichthys oxycephalus* Bleeker.

Fowler (1959, p. 288) recorded *oxyrhynchos* from Fiji without seeing a specimen. He based his record on an entry in the catalog of the Museum Godeffroy. Otherwise known only from the type locality, Goram Islands.

Amblycirrhitus unimacula (Kamohara)

FIGURE 25

Cirrhitoidea unimacula Kamohara, 1957, Rep. Usa Mar. Biol. Sta., vol. 4, pp. 2, 30, fig. 19 (type locality, Sōmachi, Ryukyu Islands).

DIAGNOSIS.—Dorsal rays X,11; anal rays III,6; pectoral rays i,8,v; lateral-line scales 48; 4 rows of large scales above lateral line

in middle of body; 12 scales below lateral line to origin of anal fin (1 specimen, Formosa; gills and viscera have been removed).

Longest pectoral rays extending slightly posterior to a vertical at anus; depth about 3.2 in standard length; origin of dorsal fin over hind edge of opercular membrane.

Color in alcohol light tan with about 10 vertical dark brown bars of unequal width, most of which narrow as they pass downward on the body; an ocellated black spot as large as eye on back above lateral line extending on to posterior half of soft portion of dorsal fin; several brown bands and blotches on head, but no large dark spot on opercle; membrane behind tip of each dorsal spine blackish, cirri pale.

REMARKS.—In the description of *unimacula*, Kamohara stated that palatine teeth were absent. Because other species of *Amblycirrhitus* have teeth on the palatines, the author wrote Kamohara requesting that he re-examine the type for such teeth. He reported that palatine teeth were present but small and difficult to see.

After Kamohara was queried, the second known specimen of this species was cataloged at the U.S. National Museum. It was collected by R. E. Kuntz in shallow water on the west coast of the island of Lan Yu, about 40 miles east of southern Formosa. The fish measures 63 mm. in standard length. The holotype (No. 6387, Biological Laboratory, Kochi University, Japan) is 85 mm. in standard length. It was taken in a tide pool at Sōmachi, Ryukyu Islands. The Lan Yu fish differs from the type as described in having 48 instead of 50 lateral-line scales, in the lower jaw not projecting anterior to the upper, and in the pelvic fins just reaching the anus instead of falling short of it.

Genus *Cirrhitichthys* Bleeker

Cirrhitichthys Bleeker, 1856, Natuurk. Tijdschr. Nederlandsch-Indië, vol. 10, p. 474. (Type species, *Cirrhites graphidopterus* Bleeker, probably by monotypy = *Cirrhites aprinus* Cuvier.) (Bleeker, 1856, reference not seen; pagination from Gill, 1862, and Bleeker, 1876–77.)

Cirrhitopsis Gill, 1862, Proc. Acad. Nat. Sci. Philadelphia, pp. 105, 109. (Type species, *Cirrhites aureus* Temminck and Schlegel, by monotypy; proposed as a subgenus.)

Acanthocirrhitus Fowler, 1938, Proc. U. S. Nat. Mus., vol. 85, p. 50. (Type species, *Cirrhites oxycephalus* Bleeker, by original designation and monotypy.)

DIAGNOSIS.—Upper 1 or 2 and lower 6 or 7 pectoral rays unbranched; dorsal soft rays 12 or 13; palatine teeth present; upper margin of preopercle coarsely serrate (the serrations usually spinous), lower margin smooth or serrate; preorbital with hind margin free for about one-fourth to three-fourths the distance from lower edge to eye (this free edge may bear small spinelike serrations in some species);

interorbital not scaled posteriorly; 3½ to 4 rows of large scales on cheek; 3 or 4 rows of large scales above lateral line in middle of body; depth of body 2.2 to 3 in standard length; snout length 2.9 to 3.8 in head length; snout pointed, profile from interorbital to upper lip nearly straight; a tuft of cirri from membrane near tip of each dorsal spine; membranes of dorsal fin moderately to deeply incised, the one between fifth and sixth dorsal spines notched more than three-tenths the length of spines; longest dorsal spine (usually fifth but may be fourth or sixth) about 1.5 to 2.6 in depth of body; first dorsal soft ray produced into a filament (with exception of *falco* and possibly *guichenoti*); pectoral fins moderately long, extending nearly to or beyond a vertical at origin of anal fin; lower unbranched pectoral rays markedly longer than branched rays (except uppermost of the lower unbranched rays of those specimens with 7 such rays); pelvic fin tips reach or extend slightly posterior to anus (except for *bleekeri* and Red Sea *oxycephalus*); caudal fin emarginate to truncate.

Key to the Species of *Cirrhitichthys*

1a. Lateral-line scales 40 to 47; 3 rows of large scales above lateral line in middle of body; dorsal soft rays 12 (rarely 13); anal soft rays 6 (rarely 7); snout length 3.2 to 3.8 in head length.

2a. Longest dorsal spine 1.7 to 2.2 in body depth; depth 2.4 to 3 in standard length; lower 6 pectoral rays unbranched.

3a. Depth 2.4 to 2.7 in standard length; bony interorbital space not narrow, its width in adults about 1.7 in diameter of eye; free hind edge of preorbital usually with one to a few small spines; spinous serrations on preopercle 17 to 22 (45 mm. standard length or greater); 6 dark bars on body (faded in some specimens), with a dark spot on lateral line on pale interspaces (East Indies and Philippines) . . **aprinus**

3b. Depth 2.7 to 3 in standard length; bony interorbital space narrow, its width in adults about 2 in diameter of eye; free hind edge of preorbital without spines (except rarely on *serratus*); spinous serrations on preopercle less than 20; no solid dark bars on body (bars, if present, comprised of spots, blotches, or dark-edged scales).

4a. Dorsal profile of head, excluding eye, with a marked indentation just above eye; orangish red bars on body in life, the first 2 usually persisting in preservative as zigzag dark lines following scale rows (probably Mariana Islands) . . . . . **serratus,** new species

4b. Dorsal profile of head, excluding eye, a slightly convex curve, without an indentation; color pattern of subquadrate dark blotches in 3 or 4 rows on body.

5a. Hind edge of maxillary falling slightly forward of a vertical at front edge of eye; fourth dorsal spine the longest; first dorsal soft ray not decidedly longer than more posterior rays (at least in sizes up to 42 mm. standard length); a group of 20 or more small dark brown spots forming a broad bar on nape and opercle, centered on origin of dorsal fin, and a second less conspicuous bar of spots centered on sixth to seventh dorsal spines (these groups of dark spots superimposed on rows of dark blotches) (Philippines) . . . . . **falco,** new species

5b. Hind edge of maxillary reaches or extends posterior to a vertical at front edge of eye; fifth dorsal spine the longest; first dorsal soft ray decidedly longer than more posterior rays (35 mm. standard length or greater); no groups of 20 or more dark spots forming bars anteriorly on body (Indo-Pacific and tropical eastern Pacific) . . . . . **oxycephalus**

2b. Longest dorsal spine 2.2 to 2.6 in body depth; depth 2.2 to 2.5 in standard length; lower 7 (occasionally 6) pectoral rays unbranched.

6a. Pelvic fins reaching anus; color not as in 6b.

7a. Median anterior part of interorbital space and region between nostrils scaled; color in alcohol uniform pale yellowish brown (orange or yellow in life) (Japan and China) . . . . . **aureus**

7b. Median anterior part of interorbital space and region between nostrils not scaled; color dark brown with a pale yellowish caudal fin which is sparsely spotted with blackish and has a broad blackish posterior border (Gulf of Oman and Red Sea) . . . . . **calliurus**

6b. Pelvic fins not reaching anus; color rosy with light longitudinal lines and a large ill-defined dark blotch below soft portion of dorsal fin; a dark spot behind upper edge of preopercle (India) (after Day) . . **bleekeri**

1b. Lateral-line scales 52; 4 rows of scales above lateral line in middle of body; dorsal soft rays 13; anal soft rays 7; snout length about 3 in head length (Réunion Island, Indian Ocean) . . . . . **guichenoti**

Cirrhitichthys aprinus (Cuvier)

FIGURE 26

Cirrhites aprinus Cuvier, *in* Cuvier and Valenciennes, 1829, Histoire naturelle des poissons, vol. 3, p. 76 (type locality, Timor).

Cirrhites graphidopterus Bleeker, 1853, Natuurk. Tijdschr. Nederlandsch-Indië, vol. 4, p. 106 (type locality, Amboina).

Cirrhitichthys aprinus Bleeker, 1876–77, Atlas ichthyologique . . ., vol. 8, p. 146, pl. 303, fig. 1 (East Indies).

Cirrhitichthys aprinus Ramsay and Douglas-Ogilby, 1886, Proc. Linn. Soc. New South Wales, vol. 10, p. 575 (Shark Reef, Port Jackson, Australia).

Cirrhitichthys analis Fowler, 1938, Proc. U.S. Nat. Mus., vol. 85, p. 48, fig. 18 (type locality, Jolo, Philippines).

DIAGNOSIS.—Dorsal rays X,12; anal rays III,6; pectoral rays i,7,vi; lateral-line scales 41 to 43; 3 rows of large scales above lateral line in middle of body; 9 or 10 scales below lateral line to origin of anal fin; gill rakers 4 or 5+1+9 to 11 (9 specimens, Philippines and East Indies).

Depth of body 2.4 to 2.7 in standard length; snout 3.5 to 3.8 in head length; longest dorsal spine 1.8 to 2 in depth; bony interorbital space about 1.7 in eye of adults; median anterior part of interorbital space and region between nostrils scaled; profile of head, excluding eye, with a marked indentation above eye; serrations on preopercle 17 to 22 (at standard lengths greater than about 45 mm.); preorbital unscaled, its free hind edge usually with one to a few spines; maxillary ending beneath anterior fourth of eye; first dorsal soft

ray prolonged; tips of pelvic fins reaching beyond anus; caudal fin slightly emarginate.

Color in alcohol light brown with 6 dark vertical bars (faded on some specimens), the middle 4 of which extend into base of dorsal fin; a dark spot on lateral line on pale interspace between the first 4 bars; a group of small dark brown spots in a diamond shape on posterior part of interorbital space and a comparable area of nape; scattered small spots anteriorly on interorbital and dorsally on snout may be present; a group of larger dark brown spots on opercle and one just above upper end of gill opening; 3 dark streaks on head, running ventrally from eye; a small blackish blotch anteriorly on dorsal fin and a larger one on the outer posterior part of spinous portion of fin; soft portion of fin spotted with black; remaining fins pale. Life color given by Cuvier and Bleeker as red with vertical blackish bars.

REMARKS.—The holotype of *aprinus* (MNHN 2774) is 61 mm. in standard length and 75 mm. in total length. Other measurements and counts of this specimen are: depth 23.5 mm.; head 20.5 mm.; snout 5.5 mm.; eye 5.5 mm.; bony interorbital 3.2 mm.; first dorsal spine 5.5 mm.; longest dorsal spine 10.2 mm.; first dorsal soft ray broken; pectoral fin 20.5 mm.; lateral-line scales 43; 3 scales above lateral line in middle of body, 4 to origin of dorsal fin, 10 to origin of anal fin; a few small scales anteriorly on interorbital; gill rakers 4+1+11; serrations on preopercle 18.

The U.S. National Museum has 8 Philippine specimens (Nos. 150609–13), 40 to 71 mm. in standard length, and the holotype of *Cirrhitichthys analis* Fowler (No. 98901). The American Museum of Natural History has a 71-mm. specimen from Bali (No. 15011). The types of *graphidopterus* Bleeker cannot be sorted from a series of 10 specimens (No. 6810) in the Rijksmuseum van Natuurlijke Historie at Leiden.

Some recent authors have erroneously used the name *aprinus* for the species *oxycephalus* Bleeker.

Cirrhitichthys serratus, new species

FIGURE 27

HOLOTYPE.—USNM 195943, a female specimen, 62.7 mm. in standard length, Pearl Harbor, Oahu, Hawaiian Islands, S. Tinker, April 1950, from a drydock hauled one year before from Guam, Mariana Islands.

PARATYPES.—USNM 195944, 10 specimens, 49.8 to 63.0 mm. in standard length; SU 55573, 2 specimens, 50.5 and 60 mm. in standard length; BM 1961.3.24.1–2, 2 specimens, 54 and 63.5 mm. in standard

length; UH 2584, 2 specimens, 51 and 60.5 mm. in standard length. All paratypes with same collecting data as holotype.

DESCRIPTION (data in parentheses are the extremes in counts and measurements for paratypes when differing from holotype).—Dorsal rays X,12; anal rays III,6 (2 paratypes with 5); pectoral rays i,7,vi (i,7,vi or ii,6,vi, usually the former); lateral-line scales 45 (44 to 47; see table 3); 3 rows of large scales above lateral line in middle of body; scales below lateral line to origin of anal fin 10 (9 or 10); gill rakers 4+1+10 (3 to 5+1+9 to 11, modally 4+1+10) (17 specimens).

Each of the following measurements is given as a percentage of the standard length. Measurements of paratypes are based on 4 USNM specimens, 49.8, 55.7, 62.0 and 63.0 mm. in standard length. Greatest depth of body 35.9 (34.5 to 35.7); width of body at gill opening 14.4 (13.6 to 15.7); head length 32.3 (32.3 to 34.3); snout length 9.6 (9.0 to 10.6); eye diameter 8.8 (8.4 to 9.0); postorbital length of head 14.3 (14.4 to 15.2); bony interorbital space 4.6 (4.3 to 4.7); least depth of caudal peduncle 12.4 (11.6 to 12.7); length of caudal peduncle 14.5 (14.3 to 14.9); snout to origin of dorsal fin 30.9 (29.5 to 31.7); snout to origin of anal fin 65.2 (63.2 to 65.4); snout to origin of pelvic fin 41.0 (40.3 to 43.5); length of dorsal fin base 59.0 (58.1 to 59.7); length of anal fin base 17.7 (16.2 to 17.5); length of pectoral fin 34.2 (34.4 to 37.7); length of pelvic fin 23.1 (21.6 to 22.9); length of pelvic spine 16.8 (14.4 to 16.7); length of first dorsal spine 7.7 (6.5 to 7.8); length of longest (the fourth or fifth) dorsal spine 18.7 (17.5 to 18.5); length of tenth dorsal spine 13.9 (13.5 to 14.3); length of first dorsal soft ray 24.0 (21.1 to 24.2); length of last dorsal ray 12.0 (11.4 to 12.4); length of first anal spine 10.3 (9.9 to 11.7); length of second anal spine 21.8 (20.5 to 22.6); length of third anal spine 16.6 (14.4 to 17.7); length of first anal soft ray 22.4 (18.0 to 21.0); length of last anal ray 15.3 (13.5 to 15.6); length of caudal fin 24.8 (24.4 to 26.9).

In addition to those of the family and genus, the following characters apply to this species: profile of head, excluding eye, with a marked indentation above eye; maxillary nearly reaching a vertical at front edge of eye; interorbital space markedly concave, scaled only anteriorly, the scaled region extending to space between anterior nostrils; preorbital not scaled, its hind margin free for about half the distance from lower edge to eye and rarely bearing a few serrations (only 2 of 17 specimens showed distinct serrations on the lower hind edge of the preorbital); margin of preopercle smoothly curved, all but anterior most part with from 11 to 19 (more on larger specimens) coarse, spinelike serrations (18 on holotype on one side and 19 on the other); suprascapula with 4 to 7 coarse serrations (6 on holotype); 4 rows of

large scales on cheek, the third row overlapping the fourth, making it narrower than preceding rows; no small scales basally on cheek scales or at margins of this scaled region except anteriorly near hind edge of preorbital; 8 or 9 large scales on opercle with a few small scales anteriorly and posteriorly; interopercle scaled; free fold of gill membranes across isthmus scaled; about 6 median predorsal scales; 8 rows of scales above lateral line on caudal peduncle on one side to lateral line on other; small scales basally on fins; first dorsal soft ray slightly prolonged; membranes of spinous portion of dorsal fin moderately incised, the one between fifth and sixth dorsal spines indented about four-tenths the length of the spines; pelvic fins reach beyond anus, almost to origin of anal fin; pectoral fins reach a vertical from base of second anal spine to second anal soft ray; second of lower unbranched pectoral rays usually the longest, extending beyond longest branched ray for a distance equal to about half the length of the branched ray; first anal soft ray unbranched; caudal fin emarginate, the caudal indentation about one-third to two-fifths eye diameter; a fringe of about 6 cirri on flap at rear of anterior nostril; cirri near tips of dorsal spines relatively thin and short.

Color in alcohol light tan with 2 broad vertical dark brown bars, one running downward from occipital region of head and anterior part of dorsal fin to upper part of opercle and the other centered at base of sixth to seventh dorsal spines and running to lateral line, these bars formed by dark edges on scales which appear as lengthwise zigzag lines (bars very faint on some specimens); a third faint dusky region on back may be seen on some specimens centered at origin of soft portion of dorsal fin, and 2 still fainter regions more posteriorly, the last dorsally on caudal peduncle; dorsal fin whitish basally, hyaline distally, the clear part of soft portion of fin with faint dusky rings about the size of the pupil; anal fin dusky, especially anteriorly in soft portion, except outer part of membranes in spinous portion which are hyaline; caudal fin hyaline with dusky spots arranged in a large median posterior crescent, those in lower part of fin darker than those in upper part; paired fins pale.

The following color note was made by L. P. Schultz on May 16, 1950, when the specimens reached the U.S. National Museum: "Upon arrival this cirrhitid was barred with bright reddish orange; mouth orange; a red bar from behind eye down across cheek, another from front of eye across preorbital, corner of mouth, meeting its fellow on underside of head; tip of chin red; red streak along middorsal line of snout to tip of snout; gill membranes over isthmus red; red spots with black margins on dorsal fin; caudal fin posteriorly with black spots; vertical red bars (on head and body) made up of red blotches which are more or less arranged in lengthwise rows."

REMARKS.—Named *serratus* both in reference to the zigzag lines that form the dark bars on the body and the coarse serrations on the preopercle.

A problem exists with respect to the type locality. Although the fish were collected in Pearl Harbor, Oahu, they were taken from around a drydock that was hauled to the Hawaiian Islands a year before from Guam, Mariana Islands. It is possible that this species came from Guam with the drydock. Three adult specimens of *Cirrhitichthys oxycephalus* that were taken at the same time as the series of *serratus* constitutes evidence in favor of an initial Mariana Islands locality, for the wide-ranging and relatively common *oxycephalus* is unknown from other collections from Hawaii.[3]

Cirrhitichthys falco, new species

FIGURE 28

HOLOTYPE.—AMNH 20412, a female specimen, 41.8 mm. in standard length, Gulf of Davao, Mindanao, Philippine Islands, Van Name Philippine Expedition, 1937.

PARATYPES.—AMNH 20413, 25.2 mm. in standard length; USNM 195954, 32.2 mm. in standard length. Paratypes with same collecting data as holotype.

DESCRIPTION (data in parentheses are the extremes in counts and measurements for paratypes when differing from holotype).—Dorsal rays X,12; anal rays III,6; pectoral rays i,7,vi (smallest paratype with upper 2 pectoral rays unbranched); lateral-line scales 42 (42 to 45); 3 rows of large scales above lateral line in middle of body; scales below lateral line to origin of anal fin 9; gill rakers 4+1+9 (3+1+9 or 10).

Each of the following measurements is given as a percentage of the standard length. Greatest depth of body 34.0 (29.3 to 32.3); width of body at gill opening 14.4 (12.7 to 14.9); head length 35.9 (35.3 to 35.7); snout length 11.2 (10.6 to 10.7); eye diameter 9.8 (10.0 to 10.2); postorbital length of head 16.0 (15.1 to 16.7); bony interorbital space 4.5 (4.4 to 4.6); least depth of caudal peduncle 12.0 (12.1 to 12.7); length of caudal peduncle 14.1 (14.7 to 15.1); snout to origin of dorsal fin 36.3 (33.8 to 35.7); snout to origin of anal fin 65.9 (62.7 to 64.7); snout to origin of pelvic fin 45.0 (42.2 to 46.2); length of dorsal fin base 55.5 (51.2 to 56.0); length of anal fin base 14.3 (14.6 to 15.8); length of pectoral fin 39.0 (30.5 to 37.6); length of pelvic fin 22.2 (21.8 to 23.3); length of pelvic spine 15.6 (15.2 to 15.4); length of first dorsal spine 8.8 (7.8 to 8.0); length of

[3] After the above was written, additional specimens of *serratus* were collected by W. A. Starck, II, D. P. de Sylva and others of the Marine Laboratory, University of Miami, in September and October 1961 at Gorgona Island, Colombia, and La Plata Island, Ecuador, within the depth range 5 to 35 feet.

longest (fourth) dorsal spine 19.1 (16.3 to 20.8); length of tenth dorsal spine 13.4 (13.5 to 14.3); length of first dorsal soft ray 22.5 (18.7 to 20.8); length of last dorsal ray 11.7 (10.9 to 11.9); length of first anal spine 10.5 (10.3 to 10.5); length of second anal spine 23.2 (22.0, broken in smallest paratype); length of third anal spine 16.4 (15.1) to 16.5); length of first anal soft ray 21.3 (18.3 to 21.7); length of last anal ray 12.2 (12.6 to 13.1); length of caudal fin 23.1 (24.9 to 25.8).

In addition to the characters of the family and genus, the following apply to this species: profile of head, excluding eye, without a marked indentation above eye; hind edge of maxillary slightly forward of a vertical at front edge of eye; interorbital space markedly concave, scaled only anteriorly, the scaled region extending slightly anterior to anterior nostrils; preorbital not scaled, its hind margin free for almost one-half the distance from lower edge to eye and bearing no serrations; preopercular margin smoothly rounded, the upper three-fifths with 11 (6 or 8) coarse serrations; suprascapula with 3 or 4 serrations (only one developed on small paratype); 4 rows of large scales on cheek, the third row overlapping the fourth, making it narrower than preceding rows; no small scales basally on cheek scales or at margins of this scaled region except anteriorly near hind edge of preorbital; 9 large scales on opercle with a few small scales anteriorly and posteriorly; interorbital scaled; free fold of gill membranes across isthmus scaled; about 7 median predorsal scales; 8 rows of scales above lateral line on caudal peduncle on one side to lateral line on other; small scales basally on fins; first dorsal soft ray not prolonged into a filament; membranes of spinous portion of dorsal fin moderately incised, the one between fifth and sixth dorsal spines indented about three-eighths length of the spines; pelvic fins reach beyond anus, almost to origin of anal fin; pectoral fins reach a vertical from base of third anal spine to first anal soft ray; second of lower unbranched rays the longest, extending beyond longest branched ray a distance contained 1.6 times in length of the branched ray; first anal soft ray unbranched; caudal fin emarginate; a fringe of about 4 cirri on hind margin of anterior nostril (only one cirrus seen on paratypes); cirri near tips of dorsal spines relatively long and thick.

Color in alcohol light brown with 5 vertical dark brown bars on body (it may equally be stated that the basic pattern consists of 3 lengthwise rows of dark blotches), the first 2 comprised of small dark brown spots (which appear superimposed on dark blotches) and the last 3 of large brown blotches; first bar, which is centered on origin of dorsal fin and passes on to opercle, decidedly darker than remaining bars; a pair of brown spots, one above and one below lateral line, between dark bars; a dark brown line running ventrally

from eye to throat and another running diagonally forward and downward from eye across maxillary and mandible to chin; a median dorsal dark band running from interorbital to upper lip; a few dark brown spots on occiput; a dark streak at base of pectoral; 3 dark spots in a vertical line at extreme base of caudal fin, the uppermost located middorsally; caudal fin crossed with 3 vertical rows of spots with slightly paler centers; dorsal fin hyaline with a few dark spots, mostly representing continuation of body bars into base of fin; anal fin hyaline with a faint brownish band from base of third spine to distal ends of first few soft rays; paired fins pale. Life color not known.

REMARKS.—This species is very closely related to *serratus*. It differs in the straighter profile of the head the fewer lateral-line scales (see table 3), the larger dorsal cirri, and in color principally in the more obvious posterior bars of dark blotches and intermediate spots and the occurrence of discrete spots to form the dark anterior bars rather than dark edges of the scales as in *serratus*. Some of these differences, such as the lack of indentation in the dorsal profile of the head of *falco* and the color pattern, may be due to the difference in the size of the specimens. The largest specimen of *falco*, the holotype, is 41.8 mm. in standard length and the smallest *serratus*, 51 mm. The holotype of *falco*, however, is definitely not a juvenile. It is a ripe female with ova up to 0.3 mm. in diameter.

TABLE 3.—*Lateral-line scales of* Cirrhitichthys serratus *and* C. falco

	42	43	44	45	46	47
C. serratus	–	–	6	8	1	2
C. falco [1]	2	2	1	1	–	–

[1] Both sides counted.

Cirrhitichthys oxycephalus (Bleeker)

FIGURE 29

Cirrhites oxycephalus Bleeker, 1855, Natuurk. Tijdschr. Nederlandsch-Indië, vol. 8, p. 408 (type locality, Amboina, East Indies).

Cirrhitichthys oxycephalus Bleeker, 1876–77, Atlas ichthyologique . . . , vol. 8, pp. 146, 147, pl. 353, fig. 1 (East Indies).

Cirrhites grandimaculatus Liénard, *in* Sauvage, 1891, Poissons, vol. 16 of Histoire physique, naturelle et politique de Madagascar, p. 211 (type locality, Mauritius).

Cirrhites murrayi Regan, 1909, Proc. Zool. Soc. London, p. 404, pl. 66, fig. 6 (type locality, Christmas Island, Indian Ocean).

Cirrhitichthys corallicola Tee-Van 1940, Zoologica, vol. 25, p. 58, text fig. 2 (type locality, Gorgona Island, Pacific coast of Colombia).

Cirrhitichthys aprinus de Beaufort, 1940 (in part; non Cuvier), The fishes of the Indo-Australian Archipelago, vol. 8, p. 9, fig. 3.

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DIAGNOSIS.—Dorsal rays X,12 (one with 13); anal rays III,6; pectoral rays i,7,vi (one with ii,6,vi); lateral-line scales 41 to 45 (usually 43 or 44); 3 rows of large scales above lateral line in middle of body; 10 scales below lateral line to origin of anal fin; gill rakers 3 to 5+1+9 to 11 (usually 4+1+10) (20 specimens, Red Sea, Phoenix Islands, Marquesas Islands, and Gorgona Island, Colombia).

Depth of body 2.8 to 3 in standard length; snout 3.5 to 3.7 in head length; fifth dorsal spine the longest, its length 1.7 to 2.2 in depth; bony interorbital space about 2 in eye of adults; median anterior part of interorbital and region between nostrils scaled; profile of head, excluding eye, without a marked indentation above eye; serrations on preopercle 14 to 19 (at standard lengths greater than about 45 mm., see fig. 1); preorbital unscaled or with a few scales, its free hind edge without spines; maxillary ends slightly posterior to a vertical at front of eye (except Red Sea specimens; on these the maxillary extending almost to center of eye); first dorsal soft ray prolonged, at least in sizes greater than about 35 mm. standard length; tips of pelvic fins extending beyond anus (except Red Sea specimens); caudal fin slightly emarginate to truncate.

Color in alcohol light tan with 4 lengthwise rows of subquadrate dark brown spots on body; in addition, a row of smaller spots on lateral line interspersed between larger spots; a series of spots as large as the last-mentioned one at base of dorsal fin; opercle and interopercle with a line of about 5 blackish spots; dark brown spots on nape, snout, and ventrally on head, those at latter location arranged in 2 bands running ventrally from eye; dorsal and caudal fins spotted with dark brown; remaining fins pale.

Life color of 70 mm. specimen from the Marquesas: light brown on back shading almost to white ventrally, with prominent dark brown to red blotches (those on caudal peduncle and above anal fin red) on head and in 4 lengthwise rows on body (in addition, 4 smaller spots in a row along lateral line between upper 2 rows); dorsal fin light brown, spotted with dark brown on spinous portion and basal soft portion of fin and with red on outer part of soft portion; cirri near tips of dorsal spines red; filamentous first dorsal soft ray yellow; caudal fin with dusky membranes and reddish rays, and spotted with red and dark brown (some spots red with dark brown centers), except distal half of upper 3 principal caudal rays which are yellowish; anal and pelvic fins reddish; pectoral fin membranes hyaline, rays dusky basally, red distally; mouth slightly reddish; iris orange with a ring of brown.

REMARKS.—The holotype (No. 5844), 61 mm. in standard length, is in the Rijksmuseum van Natuurlijke Historie at Leiden.

This cirrhitid has the greatest known range of the family, occurring throughout the tropical Indo-Pacific and eastern Pacific. There are specimens in the U.S. National Museum from the Red Sea (collected by D. S. Erdman); Christmas Island (Indian Ocean), East Indies, Philippines, Fiji, Solomon Islands (collected by W. M. Chapman); Gilbert Islands and Marquesas (collected by the author); Marshall Islands (collected by D. W. Strasburg); Phoenix Islands; Gorgona Island and Port Utria (Colombia), Panama, Costa Rica, and Cocos Island (collected by W. L. Schmitt); and Clipperton Island (collected by W. J. Baldwin).

A hawkfish from Christmas Island, Line Islands (B. P. Bishop Museum 4129) which was identified as *Paracirrhites cinctus* by Fowler (1927, p. 18) was sent to the author by E. H. Bryan, Jr. Although in poor condition, it could be identified as *C. oxycephalus*.

A 33-mm. specimen of *oxycephalus* from Madras, India, sent on loan by A. C. Wheeler of the British Museum (No. 1889.2.1.3033) bears the name *Cirrhitichthys stictos* Day. No publication could be found which lists *stictos*, and it is probably only a manuscript name.

The 3 Red Sea specimens that were examined appear differentiated from the species elsewhere in its range by having a maxillary which extends almost to a vertical at the center of the eye, shorter dorsal spines, and shorter pectoral fins (extending only slightly posterior to a vertical at end of pelvic fins). Two of the specimens have pelvic fins which do not reach the anus.

Largest specimen examined, 70 mm. in standard length. This specimen was collected with a spear in 8 feet of water from a small head of *Pocillopora* in Anaho Bay, Nuku Hiva, Marquesas Islands.

Cirrhitichthys aureus (Temminck and Schlegel)

FIGURE 30

Cirrhites aureus Temminck and Schlegel, 1843, Pisces, *in* Siebold, Fauna Japonica . . ., p. 15, pl. 7, fig. 2 (type locality, Nagasaki, Japan).

Cirrhites gibbosus Guichenot, 1869, Nouv. Arch. Mus. Hist. Nat., Paris, vol. 5, p. 199, pl. 12, fig. 2 (type locality, Macao, China).

Cirrhitichthys aureus Jordan and Herre, 1907, Proc. U.S. Nat. Mus., vol. 33, p. 161, fig. 1 (southern Japan and China).

Cirrhitichthys aureus Fowler, 1931, Hong Kong Nat., vol. 2, p. 306 (Hong Kong).

DIAGNOSIS.—Dorsal rays X,12; anal rays III,6; pectoral rays i,7,vi or i,6,vii; lateral-line scales 40 to 44; 3 rows of large scales above lateral line in middle of body; 10 scales below lateral line to origin of anal fin; gill rakers 4 to 6+1+9 (7 specimens, Japan and China).

Depth of body 2.2 to 2.5 in standard length; snout 3.4 to 3.6 in head length; longest dorsal spine 2.2 to 2.6 in depth; bony interorbital space about 1.6 in eye of adults; median anterior part of interorbital space and region between nostrils scaled; profile of head, excluding

eye, with a marked indentation above eye; preorbital unscaled, its free hind edge with or without 1 to 4 small spines; maxillary ends beneath front edge of eye; first dorsal soft ray prolonged; tips of pelvic fins reach beyond anus; caudal fin slightly emarginate.

Color in alcohol of 3 specimens from Japan (USNM 57752–53), 81 to 87 mm. standard length, uniform light yellowish brown, the fins pale yellowish. The life color is golden yellow. Two specimens in the Academy of Natural Sciences of Philadelphia from Hong Kong (ANSP 76759), 92 and 93 mm. in standard length, show about 5 faint bars on the body with short bars between centered on the lateral line and a spot on the opercle behind the eye. Fowler recorded the life color of these as golden yellow brown with brown edges to the scales, yellowish pink caudal peduncle, and red caudal fin.

REMARKS.—The types of *aureus* are in the Rijksmuseum van Natuurlijke Historie at Leiden. Boeseman (1947, p. 33) designated No. 536 as lectotype. The type of *Cirrhites gibbosus* Guichenot from Macao (MNHN 3060) is the largest specimen of *aureus* seen; it measures 117 mm. in standard length and 138 mm. in total length. Guichenot described his type as yellow, with brownish yellow back and yellowish fins.

The 4¼-in. specimen reported from Misaki, Japan, by Jordan and Herre was believed to have been taken from "rather deep water."

Cirrhitichthys calliurus Regan

FIGURE 31

Cirrhitichthys calliurus Regan, 1905, Journ. Bombay Nat. Hist. Soc., vol. 16, p. 322, pl. B, 3 (type locality, Muscat, Gulf of Oman).

DIAGNOSIS.—Dorsal rays X,12; anal rays III,6; pectoral rays i,6,vii or ii,5,vii; lateral-line scales 42; 3 rows of large scales above lateral line in middle of body; 10 scales below lateral line to origin of anal fin; gill rakers 3 or 4+1+9 or 10 (2 specimens, Red Sea).

Depth of body 2.4 in standard length; snout 3.6 in head length; longest dorsal spine 2.3 in depth; bony interorbital space 1.6 in eye; median anterior part of interorbital space and region between nostrils not scaled; profile of head, excluding eye, with a marked indentation above eye; preorbital unscaled, the free hind margin without spines; maxillary ends slightly posterior to vertical at front edge of eye; first dorsal soft ray prolonged; tips of pelvic fins reaching slightly beyond anus; caudal fin slightly emarginate, almost truncate.

Color in alcohol brown (the centers of the scales are a little paler than the edges, hence the body has a slight linear pattern); caudal fin abruptly pale yellowish with a broad blackish posterior border and about 18 small blackish spots; dorsal and anal fins brown like body; paired fins pale; lips pale. Regan stated that the fish is brown-

ish, darkly marbled (his figure shows dark bars), the soft dorsal and anal fins and caudal peduncle almost blackish, and the caudal fin pale yellowish with a pink tinge at the base, dark posterior margin and dark spots.

REMARKS.—Two specimens (MNHN 95.174–5), 57 mm. in standard length, collected by M. Jousseaume at Obock, Red Sea, were examined in Paris. Otherwise known only from the 2 original specimens, 64.5 and 84 mm. in standard length, taken at 15 to 30 fathoms off Muscat, Gulf of Oman. These are cataloged in the British Museum under No. 1904.5.25.

C. calliurus is closely related to *bleekeri* and *aureus* (see "Remarks" under *bleekeri*).

Cirrhitichthys bleekeri Day

FIGURE 32

Cirrhitichthys bleekeri Day, 1873, Proc. Zool. Soc. London, p. 705 (type locality, Madras, India).

Cirrhitichthys aureus Day, 1875, (non Temminck and Schlegel), The fishes of India . . ., p. 145, pl. 35, fig. 5, (Madras, India).

DIAGNOSIS.—Dorsal rays X,12 or 13; anal rays III,6 or 7; lower 6 or 7 pectoral rays unbranched; lateral-line scales 43 (given as 45 or 46 in original description); 3 rows of large scales above lateral line in middle of body (4 to origin of dorsal fin); 12 scales below lateral line to origin of anal fin.

Depth of body about 2.4 in standard length; profile of head, excluding eye, with a marked indentation above eye; preorbital without scales; no mention of spines on hind margin of preorbital; maxillary reaches to below first third of eye; first dorsal soft ray prolonged; pelvic fins do not reach anus; caudal fin slightly emarginate.

Color rosy with light longitudinal lines and a large ill-defined blotch below the soft portion of the dorsal fin extending half way down the side; in some specimens 2 more descend from spinous portion of dorsal fin; a small dark spot behind upper edge of preopercle; dorsal and caudal fins more or less banded, the caudal with red spots; soft portion of dorsal darker than spinous portion and having a light outer edge.

REMARKS.—Day's original description (1873) differs from his account of the species in his "Fishes of India" (1875–78, pp. 145–146) which, in turn, does not correspond in all respects with the plate (reproduced herein as fig. 32). Notable among the differences are the lateral-line scale counts (given as 45 or 46 in original description and as 43 in "Fishes of India"), size of the eye, and length of the snout and of the longest dorsal spines. These differences are impossible to resolve without seeing specimens.

No type or other specimens were located in those museums visited or at others through correspondence (see p. 391).

C. bleekeri is evidently very closely related to *aureus* and *calliurus*. Day, in fact, ultimately placed his *bleekeri* in the synonymy of *aureus*. However, the pelvic fins falling short of the anus, noted by Day, and the different color pattern seem to differentiate *bleekeri*. It is not inconceivable that *aureus*, *bleekeri*, and *calliurus* may be demonstrated eventually as subspecies of one species in continuous distribution from Japan and China to the Red Sea.

Day stated that *bleekeri* is rather common at Madras and that it attains a length of about 4 inches.

Cirrhitichthys guichenoti (Sauvage)

FIGURE 33

Cirrhites guichenoti Sauvage, 1880, Bull. Soc. Philomath. Paris, p. 221 (type locality, Réunion); 1891, Histoire Naturelle des Poissons *in* Grandidier, Histoire physique, naturelle et politique de Madagascar, vol. 16, p. 212, pl. 23, fig. 1 (Réunion).

DIAGNOSIS.—Dorsal rays X,13; anal rays III,7; pectoral rays i,7,vi; lateral-line scales 53; 4 rows of large scales above lateral line in middle of body; gill rakers 5+1+11 (1 specimen).

Depth of body about 3.1 in standard length; snout 2.95 in head length; longest dorsal spine about 1.8 in depth; bony interorbital space about 2 in eye; median anterior part of interorbital space and region between nostrils scaled; profile of head, excluding eye, with a marked indentation above eye; preorbital with a few small scales posteriorly, the free hind margin without spines; maxillary ends before eye; relative length of first dorsal soft ray unknown (this ray broken on specimen); caudal fin truncate.

Color in alcohol brown with 3 lengthwise rows of large dark brown spots; middle row of spots, which follows lateral line, with a small spot between successive large spots; a small black spot behind eye at upper end of free margin of preopercle; a dark streak from eye almost to angle of preopercle, a second running from eye to maxillary, and a third running anteriorly on snout from eye; median fins spotted with brown; cirri at tips of dorsal spines pale.

REMARKS.—The holotype (MNHN 4091) measures 112 mm. in standard length and 166 mm. in total length. Other measurements are: depth of body 35.5 mm.; width of body at gill opening 9.3 mm.; head length 38.1 mm.; snout length 12.9 mm.; snout to end of maxillary 11.5 mm.; diameter of eye 12.1 mm.; bony interorbital space 6 mm.; first dorsal spine 9 mm.; fifth dorsal spine the longest, 20 mm.; ninth and tenth dorsal spines subequal, 16 mm.; length of pectoral fins 38 mm., the tips of elongate lower rays reaching slightly posterior

to a vertical at ends of pelvic fins; length of pelvic fins 24 mm. There are 20 coarse serrations on the free margin of the preopercle.

The illustration of *guichenoti* in Sauvage (1891) is in error in failing to show the branched pectoral rays abruptly shorter than the lower unbranched rays. The lowest branched ray on the specimen is about two-thirds the length of the adjacent unbranched ray. The caudal fin is not rounded, but nearly truncate, and the first dorsal spine is slightly less than half the length of the fifth dorsal spine instead of three-fifths the length, as shown in the figure.

This species is remarkably similar in color pattern to *Cirrhitichthys oxycephalus* but is easily distinguished from this and other members of the genus by its longer snout and higher scale and fin-ray counts. Judging from the length of the one known specimen from Réunion (166 mm.), it is the largest species in the genus.

Genus *Cyprinocirrhites* Tanaka

Cyprinocirrhites Tanaka, 1917, Dobuts. Zasshi (Zool. Mag., Tokyo), vol. 29, no. 347, p. 269. (Type species, *Cyprinocirrhites ui* Tanaka=*Cirrhitichthys polyactis* Bleeker.)

DIAGNOSIS.—Generic characters are given in the key to the genera and the diagnosis of *polyactis*, which appears to be the only species in the genus.

Cyprinocirrhites seems to be closely related to *Cirrhitichthys*. Smith's (1951) belief that further study of *Cyprinocirrhites* might warrant its elevation to family rank seems unlikely.

Cyprinocirrhites polyactis (Bleeker)

FIGURE 34

Cirrhitichthys polyactis Bleeker, 1875, Verh. Akad. Wetensch., Amsterdam, vol. 15 (1874), p. 16 (type locality, Amboina, East Indies); 1876–77, Atlas ichthyologique . . ., vol. 8, p. 147, pl. 76, fig. 1.

Cyprinocirrhites ui Tanaka, 1917, Dobuts. Zasshi (Zool. Mag., Tokyo), vol. 29, no. 347, p. 269 (type locality, Tanabe, Japan).

Cyprinocirrhites stigma Fowler, 1943, U.S. Nat. Mus. Bull. 100, vol. 14, pt. 2, p. 65, fig. 11 (type locality, Labuan Blanda Island, Buton Strait, East Indies).

DIAGNOSIS.—Dorsal rays X,16 or 17 (one with 17); anal rays III,6; pectoral rays i,7,vi; lateral-line scales 47 to 49; 3 rows of large scales above lateral line in middle of body; 9 scales below lateral line to origin of anal fin; gillrakers 4+1+11 or 12 (one with 12) (6 specimens, Philippines).

Palatine teeth present; free margin of preopercle almost entirely serrate, the upper margin with 12 to 16 coarse serrations; preorbital with hind margin free for about one-fourth the distance from lower edge to eye; interorbital and dorsal part of snout scaled; 4 rows of

large scales on cheek (the lower row partially covered by third row); depth of body about 2.7 to 2.8 in standard length; snout short, not pointed, its length about 4 to 5 in head length; mouth highly oblique; lower jaw projecting anterior to upper; maxillary short, ending slightly posterior to front edge of eye; a tuft of cirri from membrane near tip of each dorsal spine; membranes of dorsal fin not deeply incised, the one between fifth and sixth dorsal spines notched less than one-fourth length of spines; third dorsal spine the longest, its length about 2.3 to 2.5 in depth of body; first dorsal soft ray produced into a filament; pectoral fins long, the longest rays reaching to a vertical at base of first or second anal soft rays; longest unbranched pectoral ray nearly twice as long as longest branched ray; tips of pelvic fins reaching or nearly reaching origin of anal fin; caudal fin lunate, the lobes extending as filaments, the caudal indentation about 1.3 to 1.5 in head length.

Color in alcohol uniform light yellowish brown, the fins pale yellowish except outer third of spinous portion of dorsal fin which is dusky. Life color probably orange-yellow.

REMARKS.—Two syntypes of *polyactis*, 84 and 92 mm. in standard length, are in the Rijksmuseum van Natuurlijke Historie at Leiden (No. 5845). M. Boeseman wrote that the larger example is in better condition than the smaller. The larger one is here designated as the lectotype.

C. polyactis is known from the 2 type specimens from Amboina, one specimen from Timor (Weber, 1913, p. 259), one from Japan (Tanaka, 1917), one from Queensland, Australia (McCulloch, 1922, p. 243), one from the Philippines (Fowler, 1943, p. 65, fig. 11), and one from Madagascar (Smith, 1951, p. 647, fig. 3). In addition, the U.S. National Museum has 6 from the Philippines.

The holotype of *Cyprinocirrhites stigma* Fowler (USNM 99505), a 42-mm. specimen, was examined. It has a dorsal fin formula of X,16 (not XI,17 as given by Fowler) and possesses palatine teeth. The dark markings on the body ascribed to the specimen by Fowler are merely regions where scales are missing. Fowler distinguished his species from *C. ui* Tanaka on the basis of several characters, most of which do not appear valid. The larger size of the eye and the longer dorsal spines of *stigma* (the latter difference not mentioned by Fowler) may be due to the difference in size of the specimens under comparison. The holotype of *ui* is about 50 mm. longer than the single specimen of *stigma*.

The largest of all the known specimens is the one from Madagascar which is 112 mm. in fork length (about 96 mm. standard length). The species appears to live at moderate depths. The Madagascar specimen, for example, was taken at 60 fathoms. The type of *C. stigma* was collected from 24 fathoms.

The deeply forked caudal fin, somewhat elongate body, and small oblique mouth of *Cyprinocirrhites* suggest plankton-feeding habits and a more open-water mode of life than that of other cirrhitids. To confirm this suspicion, the stomachs of 4 Philippine specimens, 50 to 70 mm. in standard length (one of which, a 66 mm. specimen, is a ripe female), were opened. The contents proved to be zooplankton: copepods, larval shrimp, larval crabs, fish eggs, and soft material that appears to be pelagic tunicate. Several families of tropical marine fishes have representatives that depart from a bottom-dwelling existence typical of the group to live in a semipelagic habitat. All have more lunate caudal fins, more fusiform body shape, and smaller mouths, generally, than their benthic relatives. Examples are *Paranthias* of the Serranidae, *Caesio* and *Ocyurus* of the Lutjanidae, *Clepticus* of the Labridae, and certain species of *Chromis* of the Pomacentridae. These fishes do not strain the organisms from the sea, but pick the individual plankters one by one. When danger approaches, they retire to the reef for shelter. *Cyprinocirrhites* may behave in the same way.

Genus Oxycirrhites Bleeker

Oxycirrhites Bleeker, 1857, Act. Soc. Sci. Indo-Neérlandicae, vol. 2, p. 39. (Type species, *Oxycirrhites typus* Bleeker, by monotypy.)

Fowler (1934, p. 358) created a new subfamily, Oxycirrhitinae, for the genus *Oxycirrhites*. De Beaufort (1940, pp. 13–15), on the other hand, included the species *Amblycirrhitus bimacula* in the genus. *Oxycirrhites* is here regarded as a monotypic genus of the subfamily Cirrhitinae. Generic characters are given in the discussion of *typus*.

Oxycirrhites typus Bleeker

FIGURE 35

Oxycirrhites typus Bleeker, 1857, Act. Soc. Sci. Indo-Neérlandicae, vol. 2, p. 40 (type locality, Amboina, East Indies); 1876–77, Atlas ichthyologique . . ., vol. 8, pp. 141, 148, pl. 351, fig. 2.

Oxycirrhites typus de Beaufort, 1940, The fishes of the Indo-Australian Archipelago, vol. 8, pp. 14, 15, fig. 4.

Oxycirrhites morrisi Fowler, 1934, Proc. Acad. Nat. Sci. Philadelphia, vol. 85, p. 359 fig. 109 (type locality, eastern Palawan, Philippine Islands).

Oxycirrhites seftoni Böhlke and Briggs, 1935, California Fish and Game, vol. 39, p. 375, figs. 1, 2 (type locality, off Palmilla Point, San José del Cabo Bay, Baja California).

DIAGNOSIS.—Dorsal rays X,13; anal rays III,7; pectoral rays ii,7,v or ii,6,vi; lateral-line scales 51 to 53; 4 rows of large scales above lateral line in middle of body; 10 scales below lateral line to origin of anal fin; gill rakers 5+1+11 or 12 (4 specimens, Philippines, Sumatra and Baja California).

Canine teeth in jaws small, not markedly longer than inner villiform teeth, and nearly uniform in size; palatine teeth absent; free margin of preopercle serrate, the serrations on upper limb coarse; curved hind margin of preorbital free for about one-fourth the distance from lower edge to eye; interorbital not scaled; 3 rows of large scales on cheek with a few forming an incipient fourth row; depth of body 4.4 to 4.6 in standard length (Böhlke and Briggs, 1953, p. 375, reported the depth of *seftoni* as 4.2; however their figure shows a depth of about 4.4 in standard length); snout very elongate, its length about 2 in head length; dorsal profile of head slightly concave; 2 to 4 cirri from membrane near tip of each dorsal spine (1 or none from last 2 spines); membranes between dorsal spines deeply incised, the one between the fifth and sixth spines notched nearly half the length of these spines; fourth dorsal spine the longest, its length 1.28 to 1.46 in body depth; first dorsal soft ray not produced into a filament; pectoral fin length variable, the tips of longest rays not reaching pelvic tips in Indo-Malayan form but extending to or beyond origin of anal fin in eastern Pacific form; longest branched pectoral ray contained 1.2 to 1.35 in length of longest unbranched pectoral ray; tips of pelvic fins reach slightly posterior to anus; caudal fin emarginate.

Color in alcohol pale, some specimens retaining 9 bars which slant diagonally posteriorly as they pass downward on the body, and 4 lengthwise dark bands, resulting in a cross-hatching effect on the body. The dark markings are red in life and the ground color whitish. Two lengthwise dark bands in dorsal fin.

REMARKS.—Known in the literature from 4 specimens: the type from Amboina, a specimen from Mauritius (Günther, 1860, p. 76), the type of *morrisi* from the Philippines, and the type of *seftoni* from Baja California. The holotype of *typus* is in the Rijksmuseum van Natuurlijke Historie at Leiden (No. 5846). M. Boeseman kindly supplied the following information on the specimen: standard length 84 mm., total length 100 mm., depth of body 19 mm., head length 36 mm., snout length 18.9 mm., postorbital part of head 11.2 mm., diameter of eye 6 mm., length of longest unbranched pectoral ray 18 mm., length of longest branched pectoral ray 15 mm., length of third dorsal spine 12.2 mm., length of fourth dorsal spine 13 mm., length of tenth dorsal spine 10.1 mm., length of second anal spine 13.7 mm., length of pelvic spine 9 mm., caudal indentation 4.5 mm., indentation of membrane between fifth and sixth dorsal spines 5.4 mm., number of serrations on preopercular margin 23 (20); number of pectoral rays (both sides) ii,7,v.

The type of *O. morrisi* Fowler (USNM) measures 72 mm. in standard length, and it is uniformly pale (probably faded). In his description of

morrisi, Fowler made errors (he reported lateral-line scales as 47 instead of 51; dorsal spines as IX instead of X; pectoral rays as iii,6,v instead of ii,7,v; third dorsal spine as 2¼ in head instead of 2.7; second anal spine as 2.5 in head instead of 2.7) which led Böhlke and Briggs into erroneous conclusions on most of the differences they attributed to *morrisi* and their *seftoni*.

Böhlke and Briggs distinguished *seftoni* from *typus* by the different placement and size of the bars on the body, the longer second lower unbranched pectoral ray, the shorter tenth dorsal spine (relative to the third), the shorter second anal spine, the shorter pelvic spine, larger eye, and more numerous preopercular serrations.

De Beaufort (1940, p. 16) reported and Boeseman confirmed that the type of *typus* is discolored; thus the comparison in size and placement of bars between *typus* and *seftoni* must depend on the figure of Bleeker (reproduced as fig. 3 by Böhlke and Briggs). Unless an error was made by the artist, the bars are narrower and begin more posteriorly on *typus*. More impressive than these possible differences is the similarity in pattern. Both *typus* and *seftoni* have 9 vertical oblique bars and 4 lengthwise bands (5 in figure of *typus*, but Bleeker's description gives 4). Both have 2 lengthwise dark bands in the dorsal fin.

Table 4 presents the counts and proportional measurements that Böhlke and Briggs have utilized to distinguish *seftoni* from *typus* and *morrisi*. Included also are data from a specimen (No. 1929.6.12.2) from Sumatra sent on loan from the British Museum and two specimens from Baja California collected in 1959 and 1961 off Cape San Lucas by R. Rosenblatt and associates of the Scripps Institution of Oceanography and loaned to the author.

The differences of Böhlke and Briggs appear to be resolved in the more accurate data from specimens not seen by them and from specimens collected since their paper was written. The short second anal spine of the type of *seftoni* is probably an abnormality. This spine appears blunt in the figure of the species. The two additional specimens from Baja California have a more normally pointed spine which is consistent in length with that of *typus* and *morrisi*. Instead of 1, these specimens have the upper 2 pectoral rays unbranched, and the Sumatra specimen has the lower 6 pectoral rays branched like *seftoni*; the i,7,vi count of *seftoni* is therefore no longer distinctive.

Two specimens of *Oxycirrhites* have recently been collected in Hawaii. These may be reported upon by R. and D. Morris.

Oxycirrhites is evidently a moderately deepwater form. The type of *morrisi* was dredged from 51 fathoms, the Sumatra specimen from 53 fathoms, and the type of *seftoni* from 25 fathoms. The second

specimen from Baja California was collected with rotenone at a depth of 110 to 120 feet. The third one was taken at 65 feet.[4]

TABLE 4.—*Comparison in certain counts and measurements of specimens of* Oxycirrhites

	Type of *typus* (84 mm.) [1]	Type of *morrisi* (72 mm.)	Sumatra specimen (85.5 mm.)	Type of *seftoni* (73 mm.) [2]	2d Baja Calif. specimen (53 mm.)	3d Baja Calif. specimen (73.5 mm.)
Length of longest pectoral ray in head	2.0	2.1	1.8	1.7	1.6	1.8
Length of longest branched pectoral ray in longest unbranched ray	1.2	1.23	1.30	1.35	1.34	1.28
Length of tenth dorsal spine in third dorsal spine	1.2	1.2	1.25	1.4	1.3	1.3
Length of third dorsal spine in head	3.0	2.7	2.6	2.6	2.7	2.8
Length of second anal spine in head	2.6	2.7	2.5	3.0	2.6	2.7
Length of pelvic spine in head	4.0	4.0	3.3	4.1	3.6	3.7
Diameter of eye in head	6.1	6.4	6.1	6.3	5.5	6.0
Snout length in head	1.9	2.0	2.0	2.0	2.0	2.0
Pectoral rays	ii,7,v	ii,7,v	ii,6,vi	i,7,vi	ii,6,vi	ii,6,vi
Lateral-line scales	52	51	53	51	52	53
Preopercular serrations	23	13	20	22	11	20

[1] M. Boeseman, Rijksmuseum van Natuurlijke Historie, written communication.
[2] Böhlke and Briggs (1953).

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[4] After the above was written, three specimens were collected in Piñas Bay, Panama, in 60 feet of water by Walter A. Starck II and others of the Marine Laboratory, University of Miami. A fourth specimen was speared by Starck at a depth of 35 feet at Gorgona Island, Colombia. This fish was observed in life to be concealed in, but not touching, a gorgonian. A 35-mm. kodachrome transparency taken by Starck shows 4 horizontal and 9 near-vertical maroon bars on a whitish ground color.

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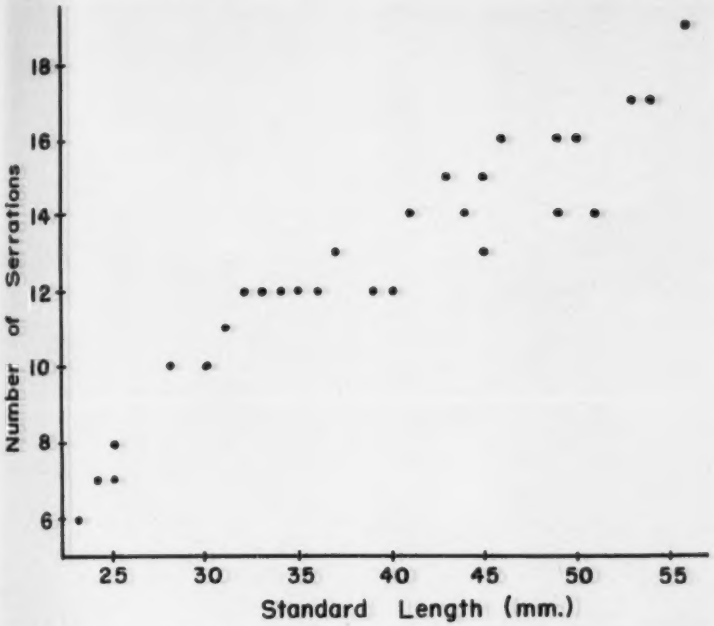


FIGURE 1.—Relationship of standard length and number of serrations on preopercle of *Cirrhitichthys oxycephalus*. Specimens from a collection from Gorgona Island, Pacific coast of Colombia.

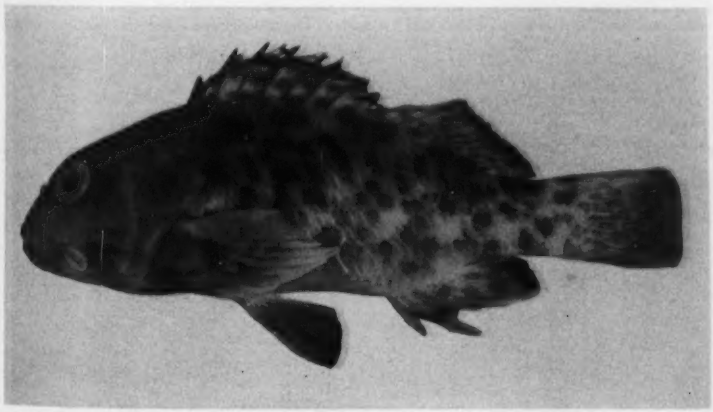
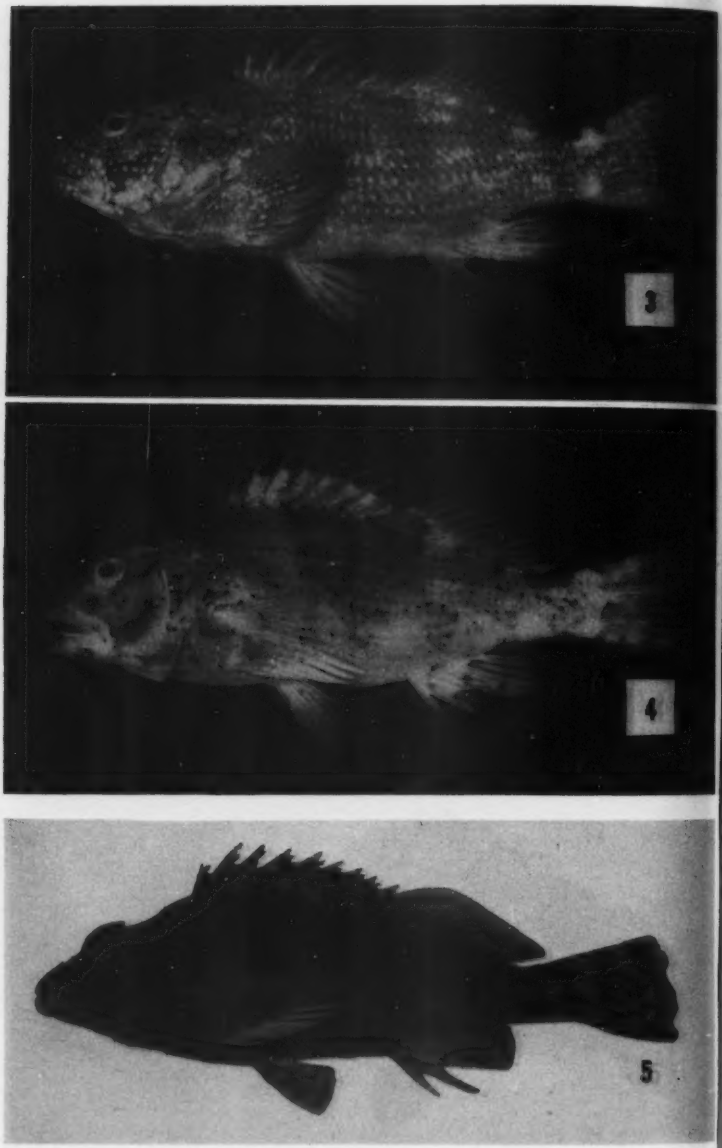
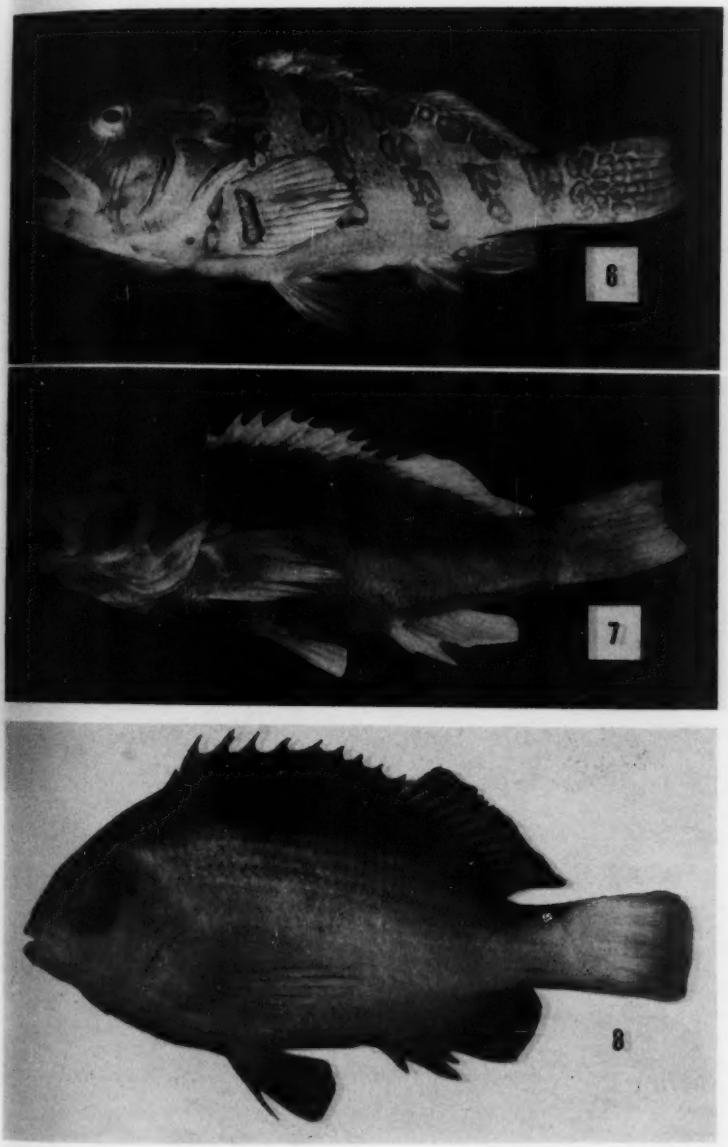


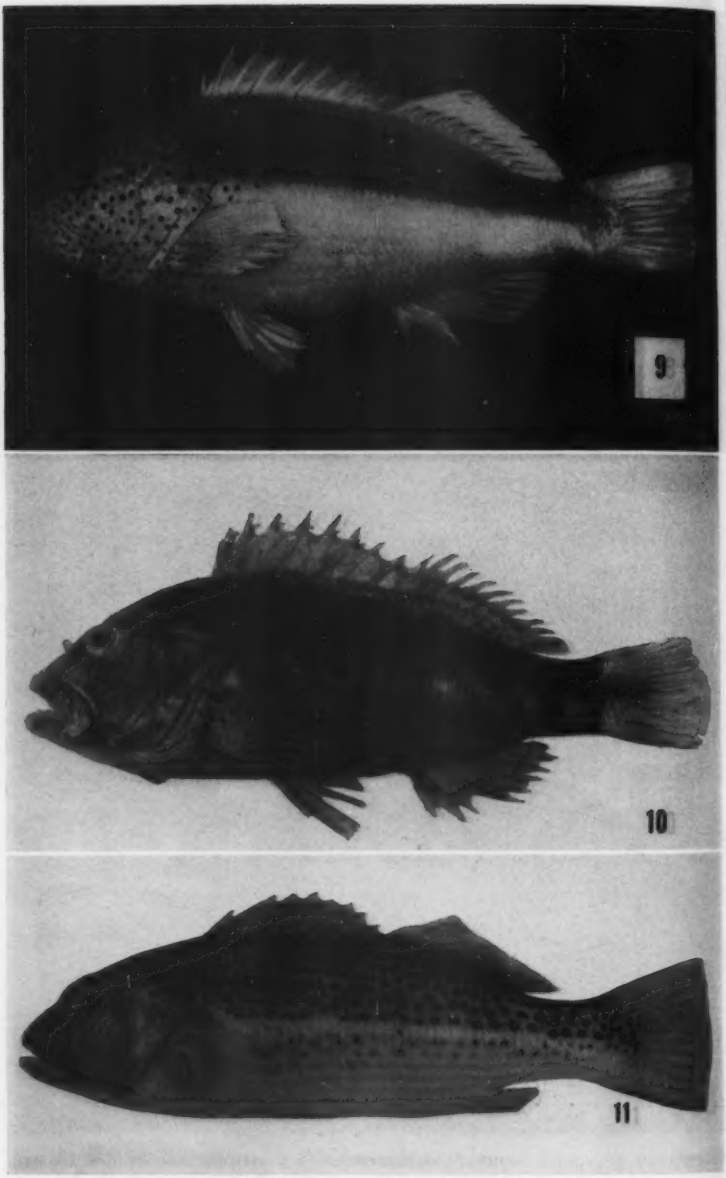
FIGURE 2.—*Cirrhitus pinnulatus* (Schneider), 87 mm. standard length, Tuamotu Archipelago USNM 164564.



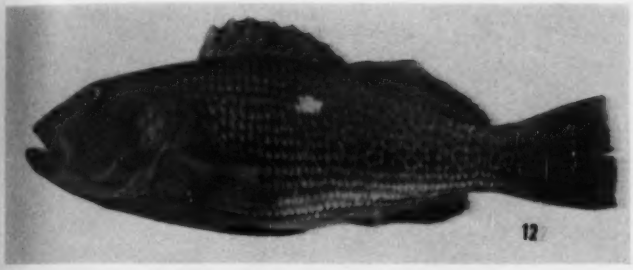
FIGURES 3–5.—Species of *Cirrhitus*. 3. *C. albopunctatus* Schultz, holotype, 100 mm. standard length, Niuafoo, USNM 91883. 4. *C. punctatus* Cuvier, 138 mm. standard length, holotype of *C. nigropunctatus* Schultz, Mauritius, USNM 13218. 5. *C. splendens* (Ogilby), 161 mm. standard length, Lord Howe Island, BM 1926.6.30.88.

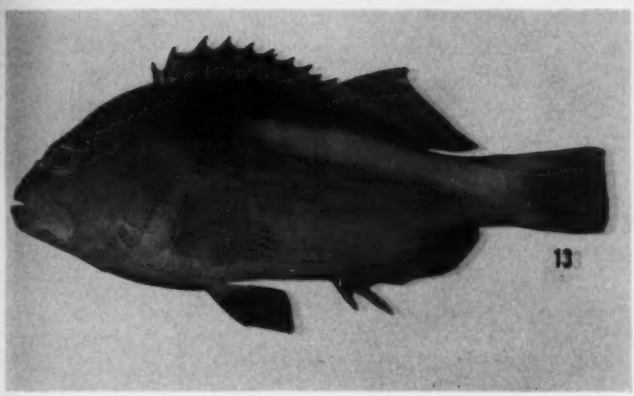


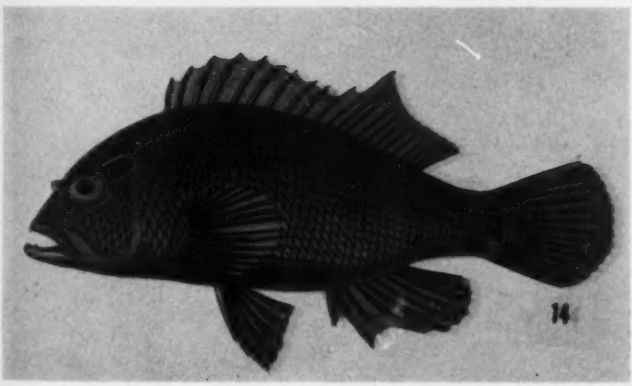
FIGURES 6–8.—Species of *Cirrhitus* and *Neocirrhites*. 6. *C. rivulatus* Valenciennes, 175 mm. standard length, Secas Island, Panama, USNM 144464. 7. *C. atlanticus* Osorio, holotype, 155.5 mm. standard length, Ilheo das Rolas, west Africa, No. 510, Lisbon. 8. *N. armatus* Castelnau, 46 mm. standard length, Caroline Atoll, USNM 190581.



FIGURES 9–11.—Species of *Paracirrhites*. 9. *P. forsteri* (Schneider), 122 mm. standard length, Gilbert Islands, USNM 167407. 10. *P. typee*, new species, holotype, 157.5 mm. standard length, Nuku Hiva, Marquesas Islands, MNHN 2908, Paris. 11. *P. hemistictus* (Günther), 175 mm. standard length, Marshall Islands, USNM 166715. From a 35 mm. kodachrome transparency.







FIGURES 12–14.—Species of *Paracirrhites*. 12. *P. hemistictus* (Günther), *polystictus* phase 190 mm. standard length, Gilbert Islands, USNM 167404. From a 35 mm. kodachrome transparency. 13. *P. arcatus* (Cuvier), 89 mm. standard length, Tuamotu Archipelago, USNM 190585. 14. *P. amblycephalus* (Bleeker), Sangi Islands (after Bleeker, Atlas ichthyologique, pl. 350, fig. 1).

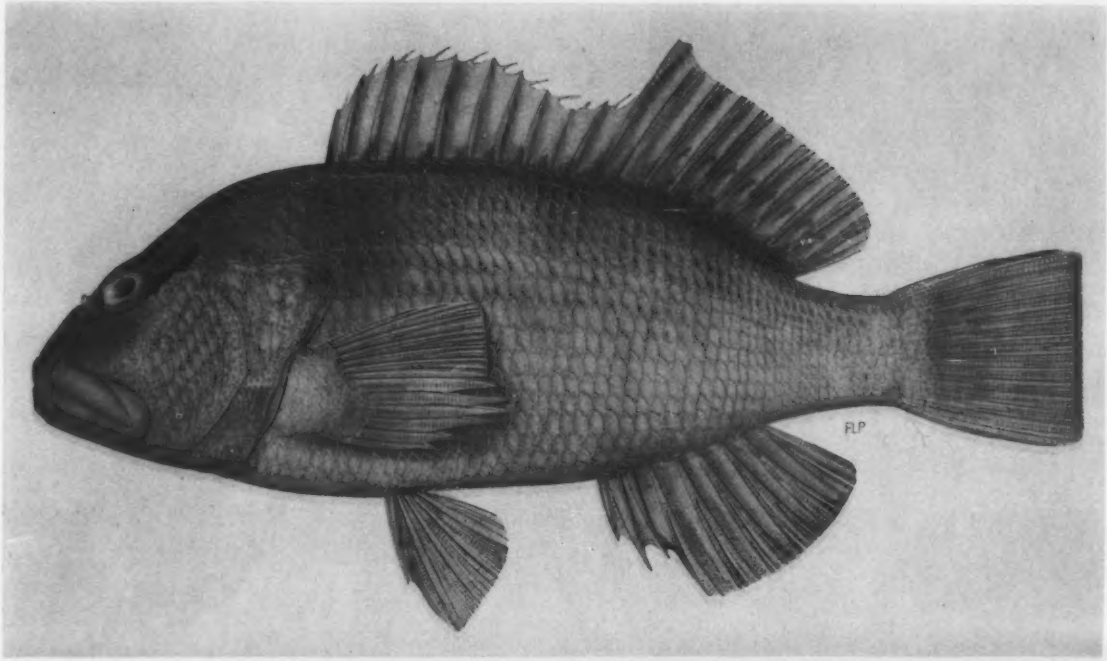


FIGURE 15.—*Paracirrhites xanthus*, new species, holotype, 104 mm. standard length, Tuamotu Archipelago, USNM 190568.

FIGURE 15.—*Paracirrhites xanthus*, new species, holotype, 104 mm. standard length, Tuamotu Archipelago, USNM 190568.

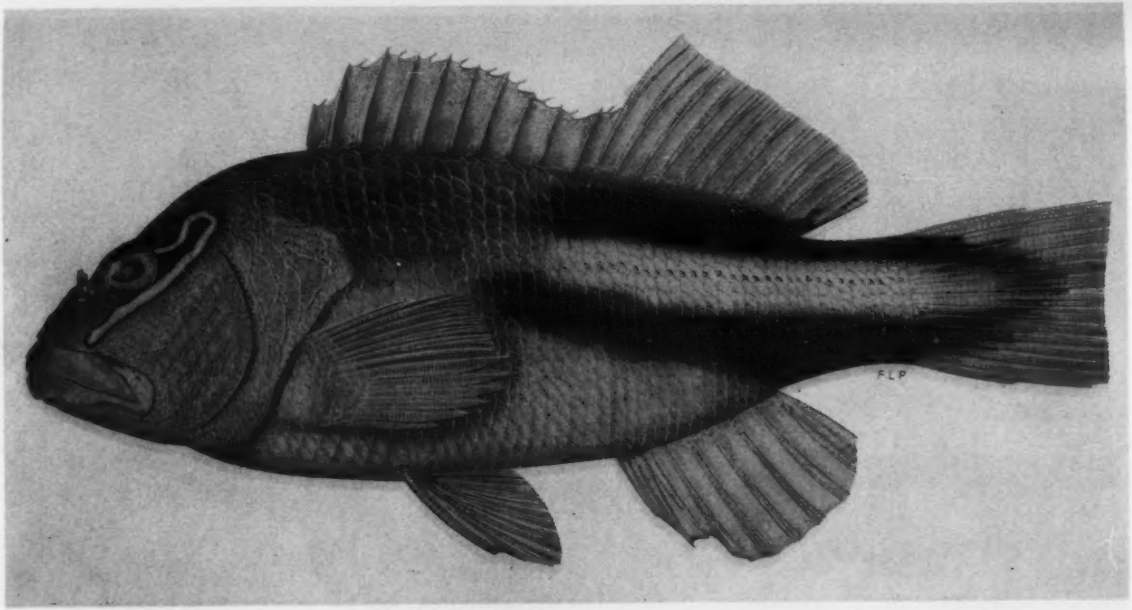


FIGURE 16.—*Paracirrhites nisus*, new species, holotype, 77 mm. standard length, Tuamotu Archipelago, USNM 190572.

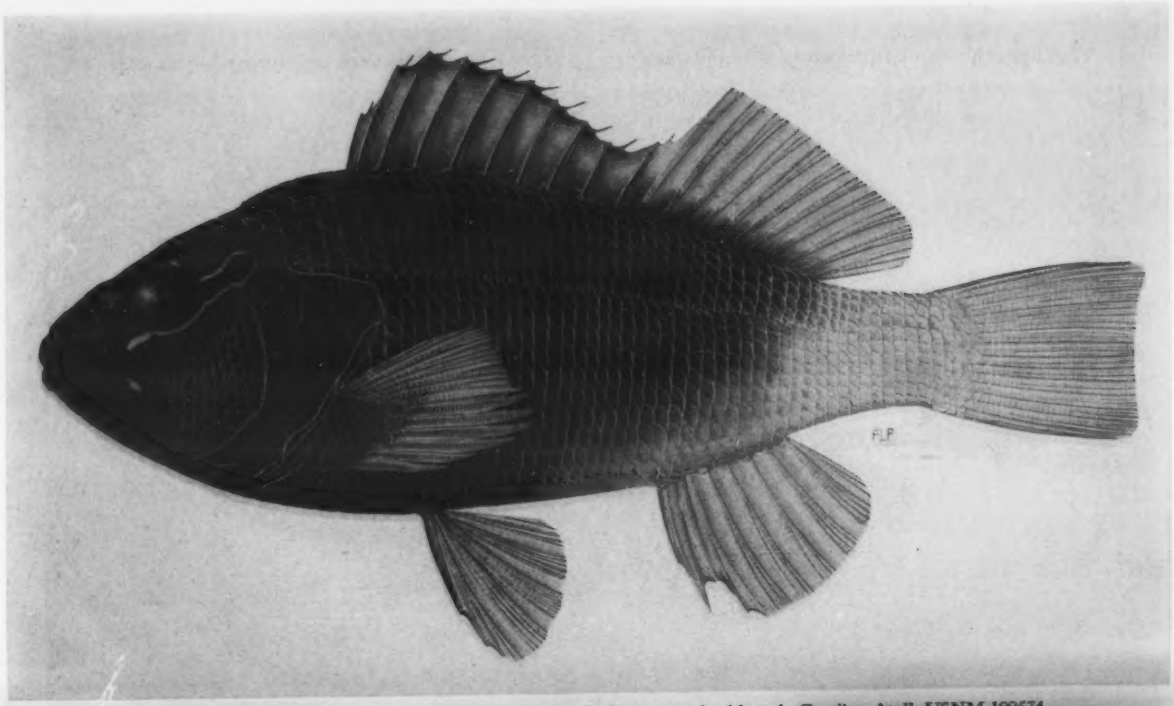
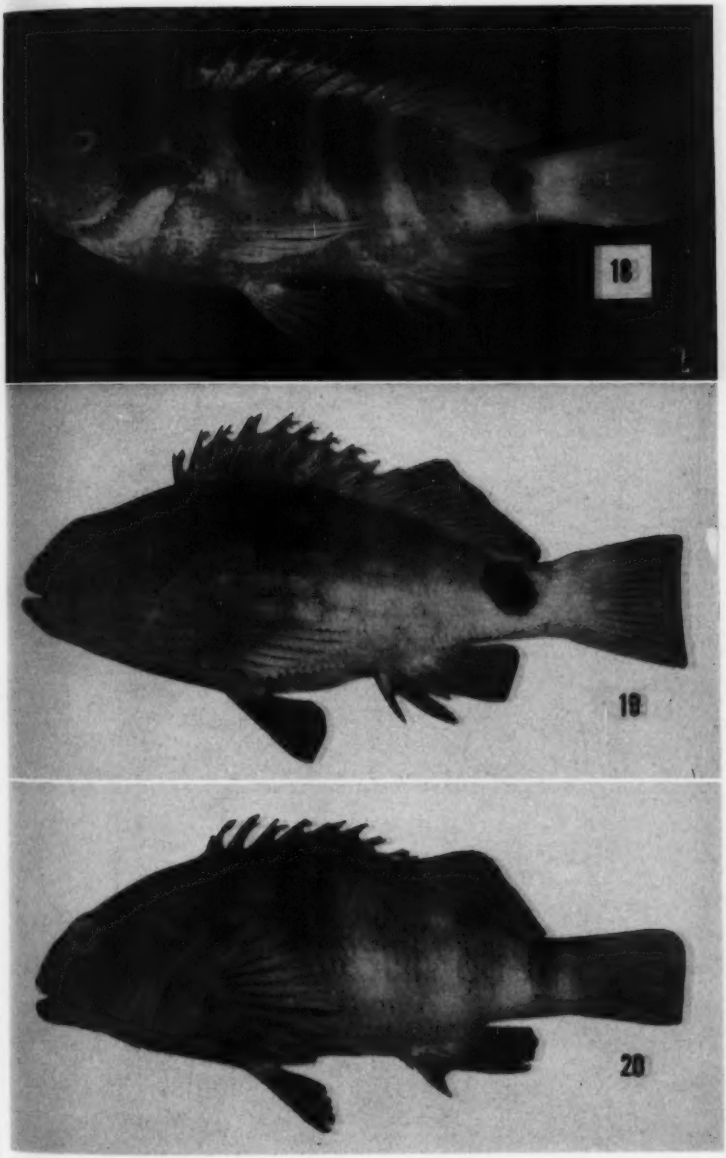


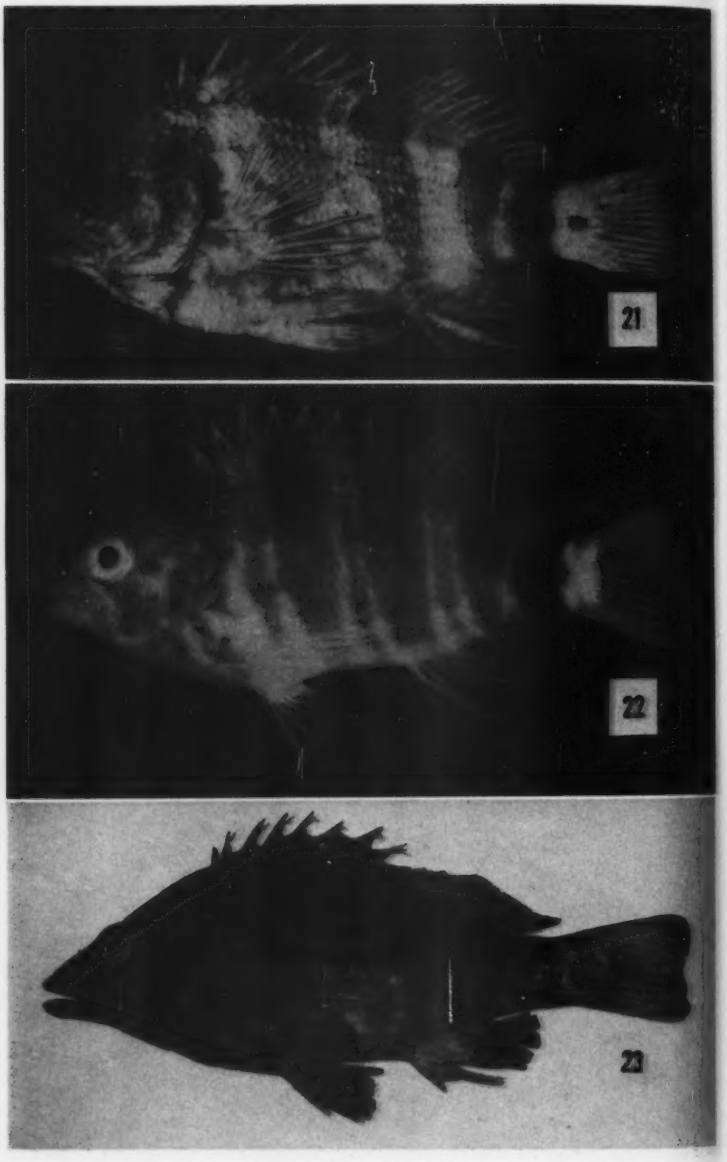
FIGURE 17.—*Paracirrhites bicolor*, new species, holotype, 73.5 mm. standard length, Caroline Atoll, USNM 190574.



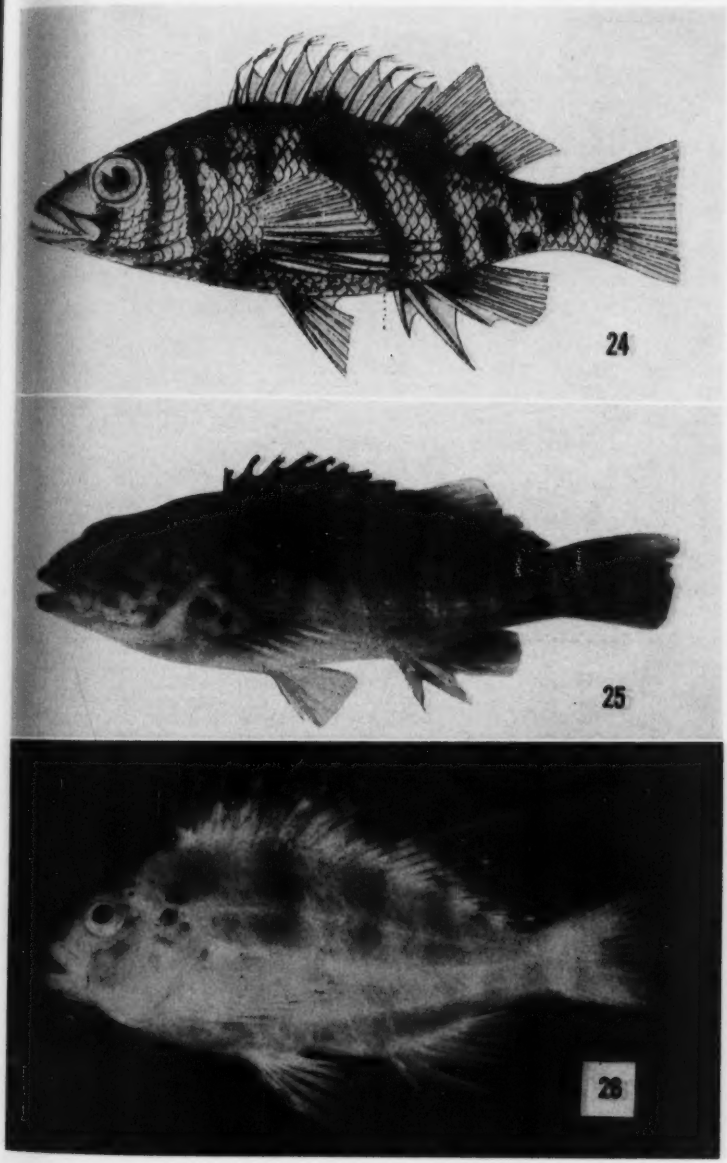
FIGURES 18–20.—Species of *Cirrhitops* and *Isocirrhitus*. 18. *C. fasciatus* (Bennett), 92 mm. standard length, Hawaiian Islands, USNM 51041. 19. *C. hubbardi* (Schultz), 70 mm. standard length, Tuamotu Archipelago, USNM 190580. 20. *I. sexfasciatus* (Schultz), 62 mm. standard length, Tuamotu Archipelago, USNM 177694.

LATE 8

FIGURE 17.—*Paracirrhites bicolor*, new species, holotype, 73.5 mm. standard length, Caroline Atoll, USNM 190574.



FIGURES 21–23.—Species of *Amblycirrhitus*. 21. *A. indicus* Fowler, holotype, 93 mm. standard length, India, MNHN 5428 A, Paris. A dried half-specimen mounted on glass. Both pelvic fins present. Fourth dorsal spine broken. 22. *A. pinos* (Mowbray), 54 mm. standard length, Virgin Islands, UMML 8438. 23. *A. bimacula* (Jenkins), 67 mm. standard length, Marshall Islands, USNM 141983.



FIGURES 24–26.—Species of *Amblycirrhitus* and *Cirrhitichthys*. 24. *A. oxyrhynchos* (Bleeker), Goram Islands (after Bleeker, Atlas ichthyologique, pl. 303, fig. 4). 25. *A. unimacula* (Kamohara), 63 mm. standard length, Lan Yu, Formosa, USNM 179312. 26. *C. aprinus* (Cuvier), 59 mm. standard length, Philippine Islands, USNM 150609.

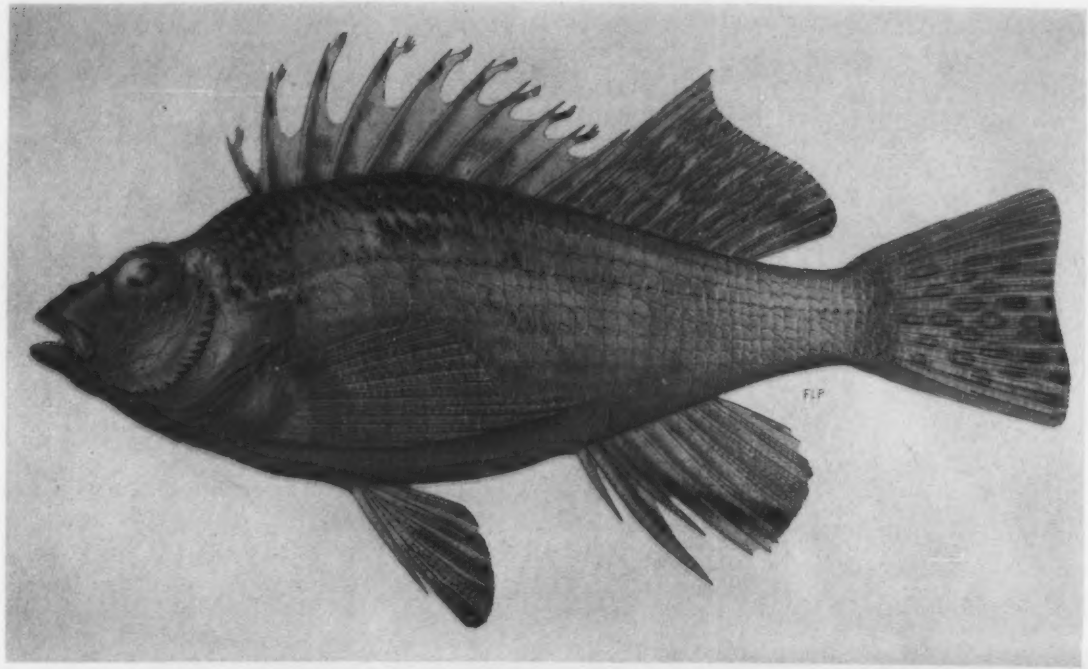


FIGURE 27.—*Cirrhitichthys serratus*, new species, holotype, 62.7 mm. standard length, Hawaiian Islands (via drydock from Guam), USNM 195943.

FIGURE 27.—*Cirrhitichthys serratus*, new species, holotype, 62.7 mm. standard length, Hawaiian Islands (via drydock from Guam), USNM 195943.

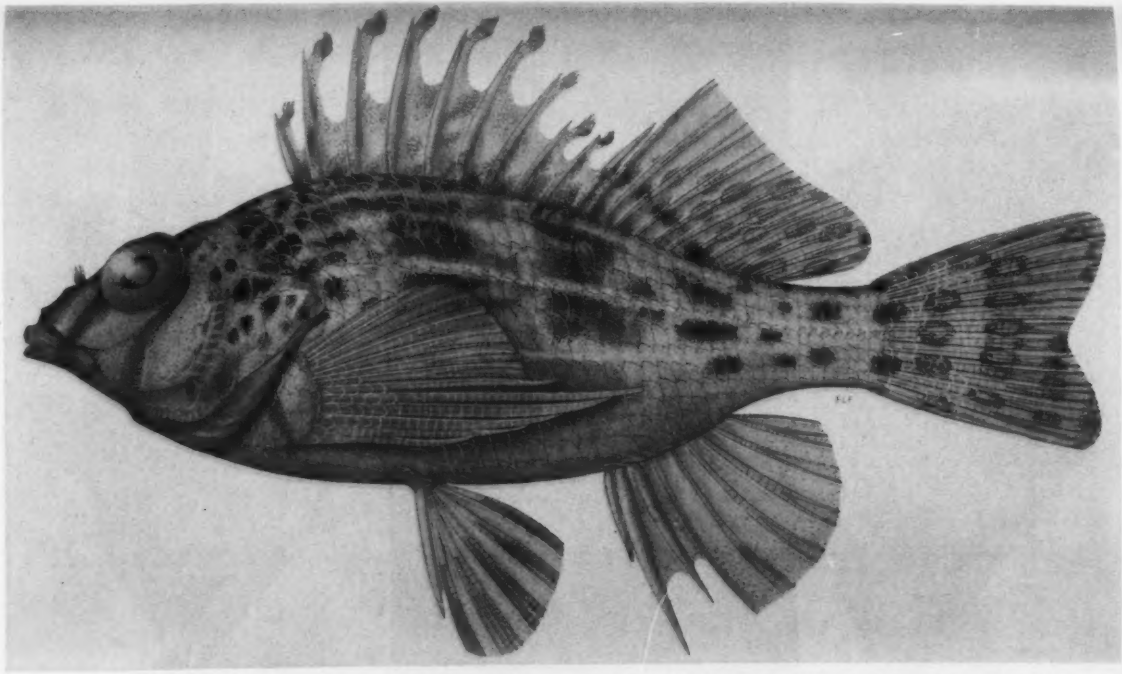
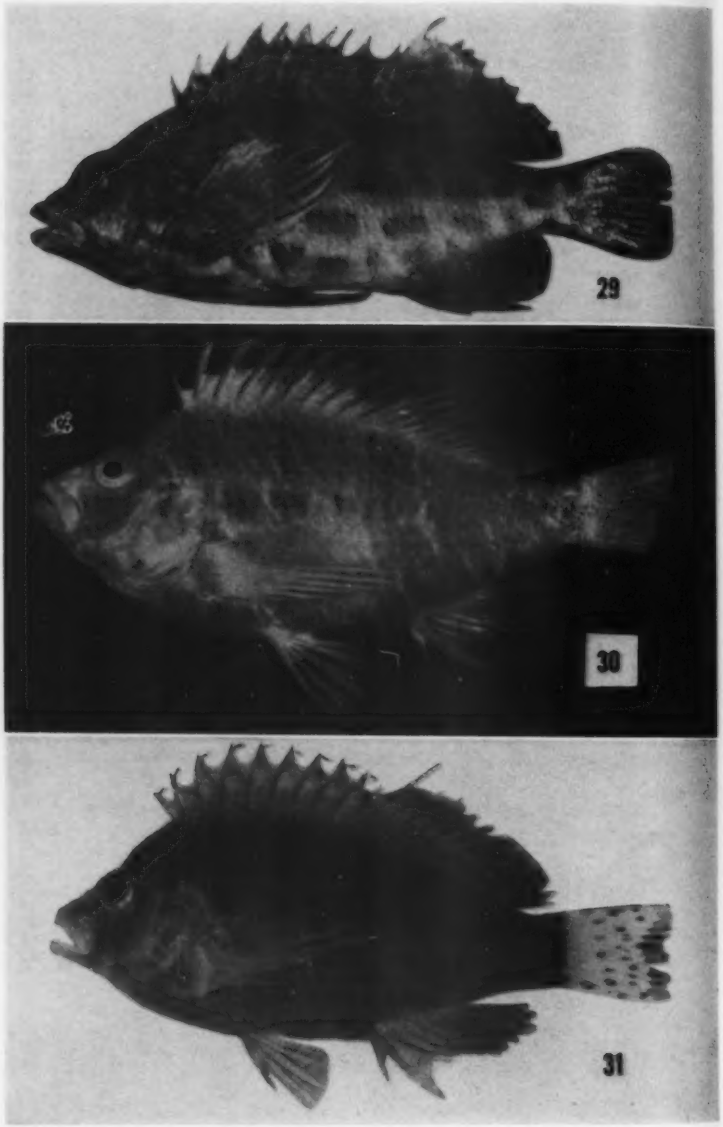
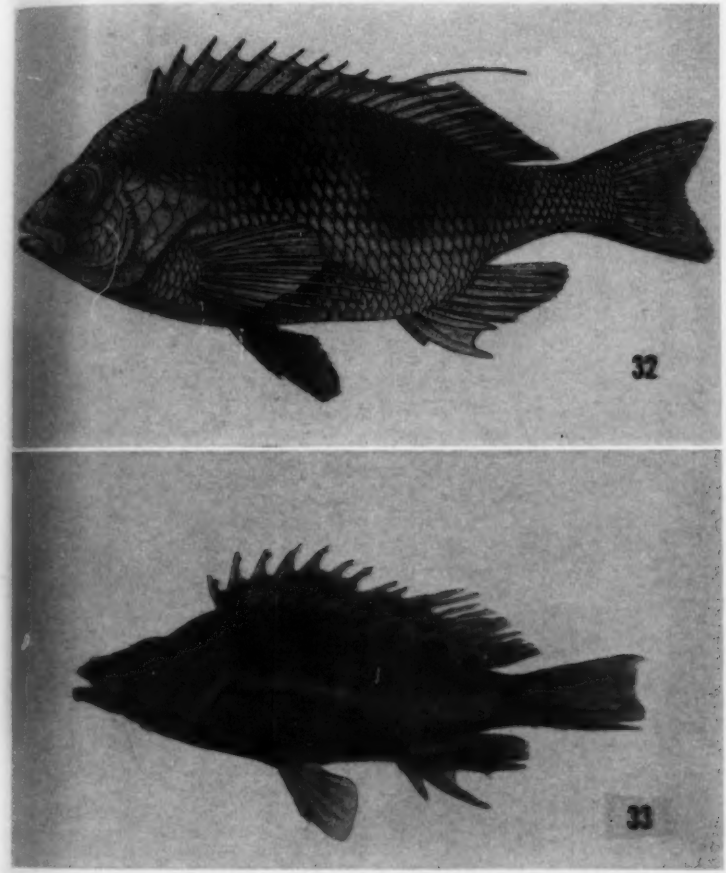


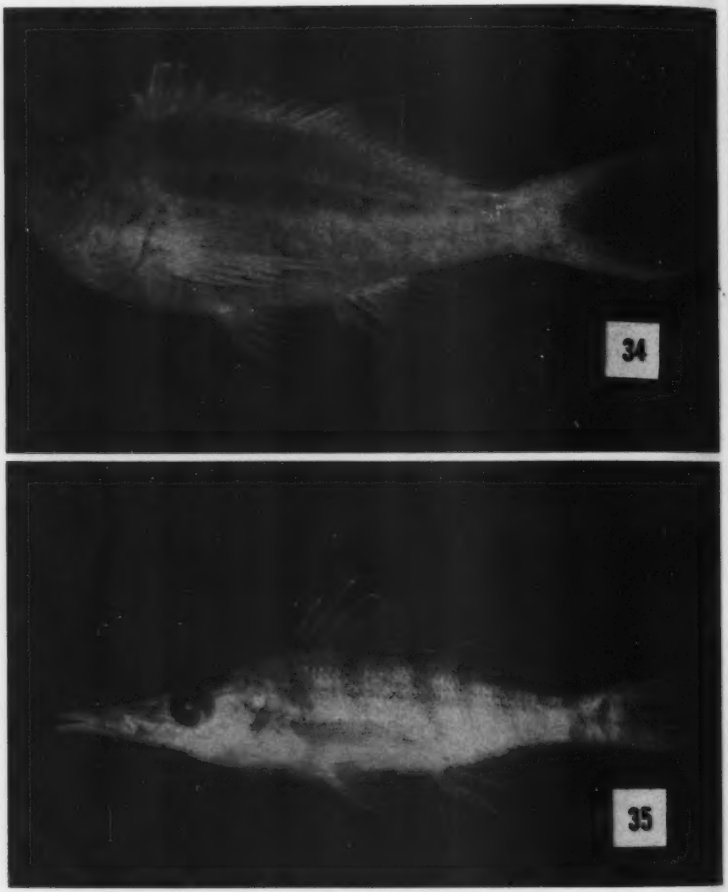
FIGURE 28.—*Cirrhitichthys falco*, new species, holotype, 41.8 mm. standard length, Mindanao, Philippine Islands, AMNH 20412.



FIGURES 29–31.—Species of *Cirrhitichthys*. 29. *C. oxycephalus* (Bleeker), 70 mm. standard length, Marquesas Islands, USNM 190576. 30. *C. aureus* (Temminck and Schlegel), 82 mm. standard length, Japan, USNM 57752. Caudal fin frayed. 31. *C. calliurus* Regan, 57 mm. standard length, Red Sea, MNHN 95174, Paris.



FIGURES 32, 33.—Species of *Cirrhitichthys*. 32. *C. bleekeri* Day, Madras, India (after Day, Fishes of India, pl. 35, fig. 5). *33. C. guichenoti* (Sauvage), holotype, 112 mm. standard length, Réunion, MNHN 4091, Paris.



FIGURES 34, 35.—Species of *Cyprinocirrhites* and *Oxycirrhites*. 34. *C. polyactis* (Bleeker), 73 mm. standard length, Philippine Islands, USNM 150615. 35. *O. typus* Bleeker, 53 mm. standard length, Baja California, SI059–215.

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STUDIES OF NEOTROPICAL CADDIS FLIES, I: RHYACOPHILIDAE AND GLOSSOSOMATIDAE (TRICHOPTERA)

By Oliver S. Flint, Jr.

Introduction

The caddis flies of the Neotropical region, though quite numerous, have received intermittent and often superficial attention. Ulmer in 1913 published the first catalog of Neotropical Trichoptera; he listed 162 species. Since then many species have been described, notably by Navas, Banks, Mosely, and Schmid, and the names available have probably trebled. There still remains much to be done in providing figures adequate by present standards of many of the species described before the mid-thirties, and in describing the many species as yet unnamed. The immature stages are almost completely unworked, although Ulmer and Müller published some valuable work on these stages around the turn of the century. It is hoped that this series of papers will fill in some of these gaps in our knowledge of all stages of the Neotropical Trichoptera. In this paper no attempt has been made to discuss all the described species; only those I have seen are treated.

For convenience, I am defining the Neotropical region as the part of North America south of the United States, South America, and all the Antillean islands. This classification is admittedly not

exactly correct, for in the caddis flies a weak Neotropical element enters the southwestern United States, and a Nearctic element extends into the highlands of central Mexico and possibly even farther in the mountains of Central America.

The terms "metamorphotype" and "pharate adult" that will be used in this series of studies are defined as follows: In the pupal stage most caddis flies are enclosed in either a sealed case or a silken cocoon and the sclerites of the last larval instar are retained with the pupa. Just prior to emergence the adult, except for the wings, is fully formed and hardened; hence the genitalia and many other structural characters are available for positive specific determination. Thus with one specimen are to be found the larval sclerites, pupal skin, and adult structures that give absolute proof of the correct association of all stages. Such a specimen was named a metamorphotype by Milne (1938). The adult found in a metamorphotype is here called a pharate adult, a term proposed by Hinton (1946) for a stage which has become free from the cuticle of the preceding instar, although the cuticle has not yet been cast off.

The material used in this study is from the following sources: The Cornell University (CU) collection, for the loan of which I am grateful to Dr. H. Dietrich and Dr. J. G. Franclemont; the undetermined material in the collection of the Museum of Comparative Zoology (MCZ) at Harvard University, for which I am indebted to Dr. P. J. Darlington, Jr.; a collection made in Ecuador by Dr. R. W. Hodges while on an expedition supported by a National Science Foundation grant to Dr. G. W. Prescott; the holotypes and allotypes of the species described from Dr. Hodges' collection are being deposited in the United States National Museum; and the collection of the U.S. National Museum (USNM).

Family Rhyacophilidae

The typical subfamily Rhyacophilinae is absent in the Neotropical region, its place being taken by the Hydrobiosinae. To date, 16 hydrobiosine genera have been described from the Neotropical region. Of these genera, *Atopsyche* Banks is the largest in included species (30 described to date) and occupies the greatest range, from southwestern United States to northern Argentina. The southern tip of South America, however, contains a great number of smaller genera, some members of which are found at least as far north as Ecuador.

Because I have not seen examples of most genera, the following key is based on the published figures of their venation. The male genitalia are often sources of characters supplementary to the venational characters. For an explanation of the venational terminology used, see Ross (1956, fig. 154).

Key to Neotropical Genera of Hydrobiosinae

1. R_3 of forewing apparently arising from R_4 rather than R_{2+3}. **Neoatopsyche** Schmid
   R_3 arising from R_{2+3} 2
2. R_{2+3} of forewing forked at r or s, cell R_2 long 3
   R_{3+3} forked nearer margin, cell R_2 short 9
3. R_{4+5} of forewing forked near wing margin and pedicel longer than either branch . . . . . **Metachorema** Schmid
   R_{4+5} forked slightly basad of fork of R_{2+3} 4
4. Forewing with crossvein m present 5
   Forewing lacking m 8
5. Two m–cu crossveins present in forewing . . . . . **Rheochorema** Schmid
   Only 1 m–cu crossvein 6
6. R_{2+3} of hindwing unforked . . . . . **Microchorema** Schmid
   R_{2+3} of hindwing forked 7
7. R_{2+3} of hindwing forked at r, m–cu arcuate . . . . **Australobiosis** Schmid
   R_{2+3} forked beyond r, m–cu straight . . . . . **Clavichorema** Schmid
8. In forewings, crossvein s present . . . . . **Neochorema** Schmid
   Crossvein s absent . . . . . **Iguazu** Ross
9. Crossvein m present in forewing . . . . . **Pseudoradema** Schmid
   Crossvein m absent 10
10. R_{4+5} unforked in hindwing 11
    R_{4+5} forked in hindwing 12
11. M_{3+4} of forewing bowed sharply toward Cu_1; M_4 and Cu_{1a} close together. **Atopsyche** Banks
    M_{3+4} not bowed sharply toward Cu_1 . . . . . **Dolochorema** Banks
12. R_{3+3} of hindwing apparently arising from R_4 13
    R_{3+3} arising independently from Rs 15
13. R, Rs, M, and Cu in forewing bearing double rows of hairs, in male at least. **Stenochorema** Schmid
    These veins not abnormally hairy. 14
14. Crossvein s present in forewings . . . . . **Cailloma** Ross
    Crossvein s absent . . . . . **Parachorema** Schmid
15. Crossvein r lacking in forewing, R_{4+5} about half length of R_{2+3} in hindwings. **Australochorema** Schmid
    Crossvein r present, R_{4+5} and R_{2+3} of equal length. **Neopsilochorema** Schmid

Genus *Atopsyche* Banks

Atopsyche Banks, Tran. Amer. Ent. Soc., vol. 32, p. 17, 1905.

Two additional species of this genus, discovered in material from South America, are described below. I have also studied larvae, representing four species, that belong to this genus. Although the larva of only one species is tentatively correlated with the adult, the larvae of all four species are described in order to indicate the type of interspecific variation likely to be found in the genus. A rather complete description is given of the larva and pupa of one species so that material may be provided that may be useful in phylogenetic work.

***Atopsyche clarkei*, new species**

FIGURE 1,*a–d*

That this most interesting species fits best in the *batesi* group of the subgenus *Atopsaura* is attested by the articulated dorsal appendage of the aedeagus and the apicomesal projection of the basal clasper segment. However, the odd invaginations of the third and fourth terga of the male are known only in the *kingi* complex of the subgenus *Atopsyche*, which group the species further resembles in the shapes of the basal segment of the clasper and of the paracercus.

ADULT.—Length of forewing, ♂ 7 mm., ♀ 8 mm. General structure typical of the genus. Color of specimens in alcohol yellowish brown; wing membrane brown with 3 whitish streaks on forewing, (1) from base of cell R_4 to base of cell M_3, (2) obliquely from fork of R_{2+3} and R_{4+5} to m–cu, and (3) inwardly from notch in posterior margin along curve of Cu_2. Abdomen with posteroventral processes mesally on segments 6 and 7, both reaching nearly to posterior margin of segment 8. Third and fourth terga of the male with an anterolateral ovoid invagination, each appearing to bear many short hairs internally. Male genitalia (fig. 1,*a*,*b*): Paracercus roughly quadrate, with apical angle produced, and bearing a number of short broad setae along dorsal margin; filicercus short, 2–3 times as long as cercus and bearing a long seta apically; clasper with basal segment rather broad, about 3½ times as long as broad, with an apicomesal projection that bears numerous short, stout setae mesally; apical segment slender and curving ventromesally; aedeagus (fig. 1,*c*,*d*) with a ribbonlike, freely articulated dorsal appendage, a simple internal rod, and narrow body bearing lateral flanges.

Holotype ♂, allotype ♀, paratype ♂: Colombia: Cundinamarca, Chicó, 2800 m., Jan. 24, 1959, J. F. G. Clarke (USNM Type 66016).

***Atopsyche neolobosa*, new species**

FIGURE 1,*e–h*

This species is very closely related to *lobosa* Ross, which is known from Bolivia, but differs in a number of small characteristics. The apex of the paracercus is not rolled outwardly, nor is the tip of the filicercus strongly clavate. The aedeagus also seems to be shorter and broader, with the dorsal process of a different shape.

ADULT.—Length of forewing, ♂ 7–9 mm., ♀ 11–12 mm. Coloration and wing maculation of specimens in alcohol much as in *clarkei*. Abdomen with ventral posteromesal projections from segments 6 and 7, that of 6 barely reaching posterior margin of segment 7, that of 7 only one-half as long as segment 8; male with a short lateral filament on segment 5, 2–3 times as long as wide. Male genitalia (fig. 1,*e*,*f*): Paracercus slender, with a high, slightly recurved point at midlength,

apex slightly flattened and twisted, filicercus long, slender, slightly widened apically; clasper with basal segment about 5 times as long as broad and with an apicoventral lobe; apical segment cylindrical, curving mesad; aedeagus (fig. 1,*g*,*h*) with a pair of dorsomesal processes produced into a strong recurved hook, and a cluster of spicules dorsally, internal rod simple, body enlarged basally, with thin lateral flanges.

Holotype ♂, allotype ♀, paratypes 1 ♂, 5 ♀: Ecuador: Papallacta, 10,500 ft., Jan. 28, 1958, R. W. Hodges (USNM Type 66017).

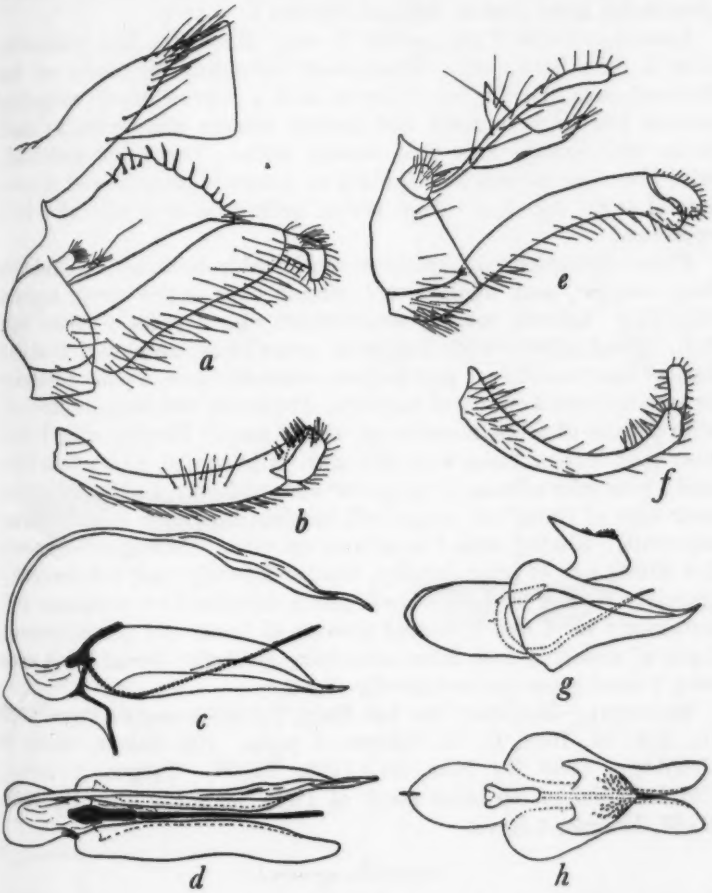

FIGURE 1.—*a–d*, *Atopsyche clarkei*: *a*, male genitalia, lateral view; *b*, right clasper, ventral; *c*, aedeagus, lateral; *d*, aedeagus, dorsal. *e–h*, *Atopsyche neolobosa*: *e*, male genitalia (ninth and tenth terga omitted), lateral; *f*, right clasper, ventral; *g*, aedeagus, lateral; *h*, aedeagus, dorsal.

Atopsyche alconura Ross (?)

FIGURE 2,*a–d*

Of this species, I have several larvae and a single pupa in which the male genitalia are developed enough to be suggestive of *alconura*, but not enough to be certain. The other larvae are associated with this specimen by means of the included larval sclerites in the metamorphotype.

The larva agrees in structural characteristics with the detailed description given that of *Atopsyche* species 1.

LARVA.—Length 7 mm., width 1 mm. Head (fig. 2,*a*) yellowish, with a dark brown area dorsomesally extending anteriorly on the frontoclypeus (lacking on 1 larva) and a narrow band extending around the sides to meet and greatly enlarge midventrally; dark areas with conspicuous pale muscle scars. Pronotum yellowish, with brown on posterior half, black on posterior margin, and anterolateral angle (fig. 2,*a*). Anal proleg lacking basoventral spine in 1 specimen.

PUPA.—Length 6 mm.; specimen considerably deformed. Mandibles long, slender, and toothed and serrate over entire inner margin (fig. 2,*c*). Labrum roughly semicircular with 7 pairs of setae (fig. 2,*d*). Head capsule with 3 pairs of setae below antennae, 1 above base of each mandible, 1 pair between antennal bases, 4 pairs posterior to antennae and 3 on rear of each eye. Pronotum and metanotum each with 2 pairs of setae, mesonotum with 3 pairs. Foreleg with 1 seta near apex of coxa, 2 near apex of femur. Midleg with 1 seta near base and 2 near apex of coxa, 2 setae near apex of femur, and 2 contiguous near apex of tibia; hair fringe well developed on both sides of tarsal segments. Hindleg with 1 small seta on coxa. Abdominal segments 1–8 with a pair of setae dorsally, another laterally, and 4–5 ventrally (possibly lacking on 1–4). Hook plates anteriorly on segments 2–7, posteriorly on 4 and 5; actual number of hooks per plate obscure. Apex of abdomen with lobes containing genitalia; dorsal lobes each with 3 stout setae posterolaterally (fig. 2,*b*).

MATERIAL.—Ecuador: Río San Daly, 3.3 miles east of Puyo, 2500 ft., Apr. 16, 1958, R. W. Hodges, 1 pupa. Río Saloya, north of Chiriboga, 6500 ft., Mar. 31, 1958, R. W. Hodges, 1 larva.; Río Rebadiniera, 10 miles north of Puyo, 3000 ft., Apr. 18, 1958, R. W. Hodges, 1 larva.

Atopsyche species 1

FIGURE 3

The larva of this species was chosen for detailed description only because it is relatively large and the structures are more distinct.

The structure of the mouth parts, legs, and other sclerotized areas of the body seem to be generically constant, at least in the other larvae of this genus known to me. Inasmuch as the larva of only one other Neotropical hydrobiosine genus (described on p. 462) is known, it is impossible to prepare generic keys to the larvae.

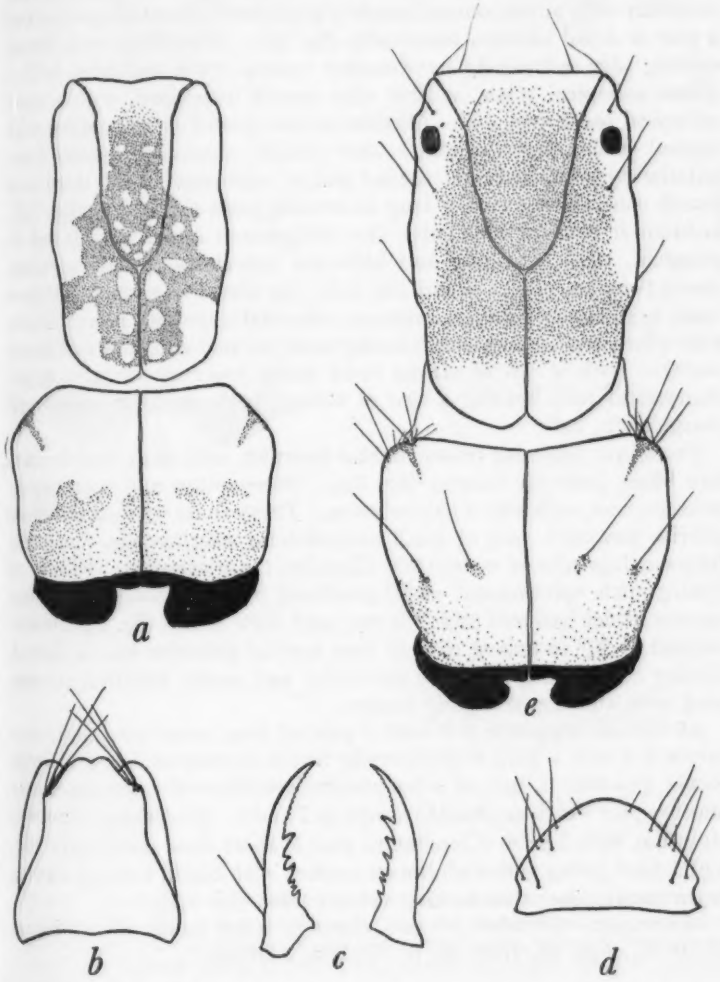

FIGURE 2.—*a–d*, *Atopsyche alconura?*: *a*, larval head and pronotum, dorsal view; *b*, apex of pupal abdomen, dorsal; *c*, pupal mandibles, dorsal; *d*, pupal labrum, dorsal; *e*, *Atopsyche* species 2, larval head and pronotum, dorsal.

LARVA.—Length 23 mm., width 3 mm. Head yellowish, with brown area middorsally and extending anteriorly along frontal sutures and with conspicuous pale muscle scars; slightly darker laterally with indistinct pale muscle scars (fig. 3,*a*). Setae arranged as in figure 3,*a*, most greatly reduced in length. Labrum dorsally with seta 5 erect and pigmented, remainder decumbent and colorless, lateral brush weak; ventrally with an apicomesal patch of posteriorly directed spicules and a pair of ovoid sclerites submesally (fig. 3,*c*). Mandibles with dorsal cutting edge completely overhanging ventral, each mandible with 2 dorsal subapical teeth; ventral edge poorly developed, with 1 small subapical tooth (fig. 3,*d*). Maxilla as seen from ventral surface with typical cardo; stipes angulate near middle, appearing jointed here; palpifer typical; first and second palpal segments short, third and fourth each about twice as long as second; galea cylindrical (fig. 3,*b*). Labium in ventral view with the submentum apparently fused to praegula, whole elongate and bifurcate anteriorly; palpal segment about twice as long as broad (fig. 3,*b*). In dorsal view the membrane basal to galea, with 2 large flattened setae and numerous hairs; labium with a large apicolateral lobe bearing many normal and flattened setae; mentum with a row of strong teeth along posterior margin; hypopharyngeal rods bearing a row of strong teeth on their apicomesal margins (fig. 3,*b*).

Pronotum yellowish brown, darker laterally, with dark muscle scars and black posterior margin (fig. 3,*a*). Mesonotum and metanotum membranous, each with 3 pairs of setae. Prosternum with a large mesal sclerite bearing a pair of small anterolateral sclerites (fig. 3,*e*), area between legs almost completely filled by these sclerites. Femur of foreleg with apicoventral angle produced into a thumblike process against which reduced tibia, tarsus, and claw closes (fig. 3,*f*); femur twisted at 90° to axis of coxa so that normal posterior face is dorsal. Midleg and hindleg normally developed and nearly identical, except hind tibia and tarsus slightly longer.

Abdominal segments 2–9 with 1 pair of long setae ventrally; segments 1–9 with a long setae laterally (much shorter on 1 and 9); segments 1–8 with a pair of setae posterodorsally, and more anteriorly another pair which are minute except on 7 and 8. Ninth tergite brown, straplike, with 3 pairs of long and 1 pair of short setae posteriorly (fig. 3,*g*). Anal proleg yellowish brown marked with black, bearing a stout basoventral spine; claw lacking ventral teeth (fig. 3,*h*).

MATERIAL.—Ecuador: stream about 5 miles south of Antisana, 13,500 ft., Apr. 28, 1958, R. W. Hodges, 2 larvae.

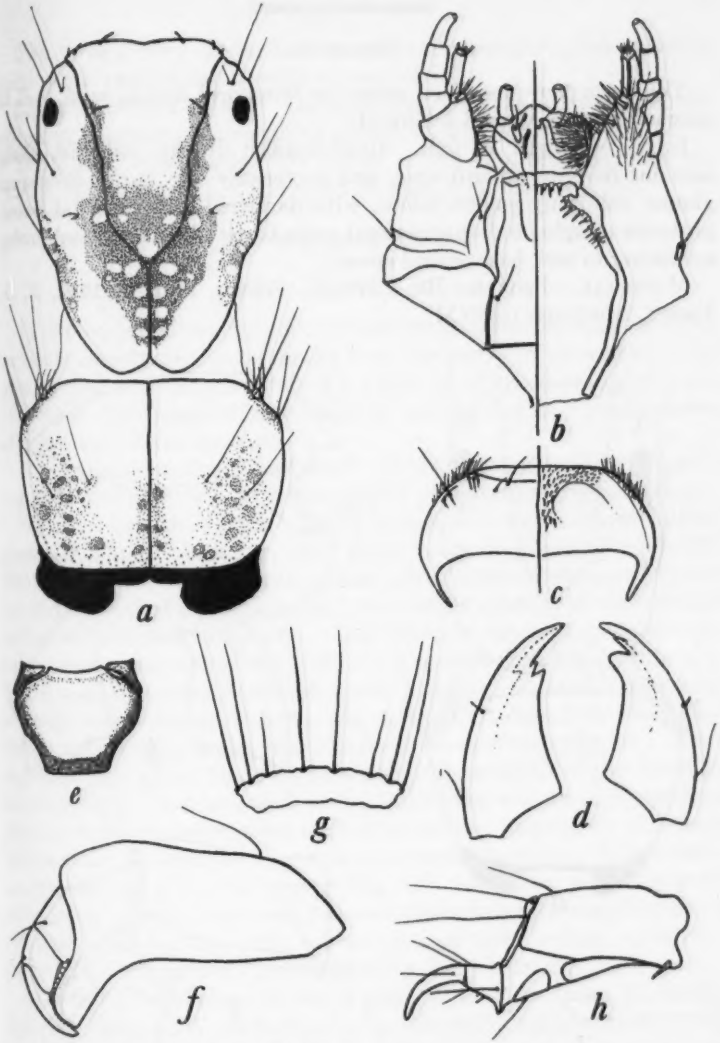

FIGURE 3.—*Atopsyche* species 1: *a*, larval head and pronotum, dorsal view; *b*, larval maxillolabium, ventral side to left, dorsal side to right; *c*, larval labrum, dorsal side to left, ventral side to right; *d*, larval mandibles, dorsal; *e*, larval prosternum, ventral; *f*, femur through tarsal claw of larval foreleg, posterior face; *g*, larval ninth tergite, dorsal; *h*, right anal proleg of larva, lateral.

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Atopsyche species 2

FIGURE 2,*e*

The larva here described agrees in structural details with that of species 1, but is colored differently.

LARVA.—Length 12 mm. Head reddish brown, yellowish along anterior margin, around eyes, and posteriorly (fig. 2,*e*). Pronotum almost uniformly golden-yellow, with darkened spots at setal bases, posterior margin, and anterolateral angle black (fig. 2,*e*). Anal proleg appearing to lack basoventral spine.

MATERIAL.—Panama: Río Chiriquí, Volcán, Mar. 1, 1924, F. J. Foster, 1 prepupa (USNM).

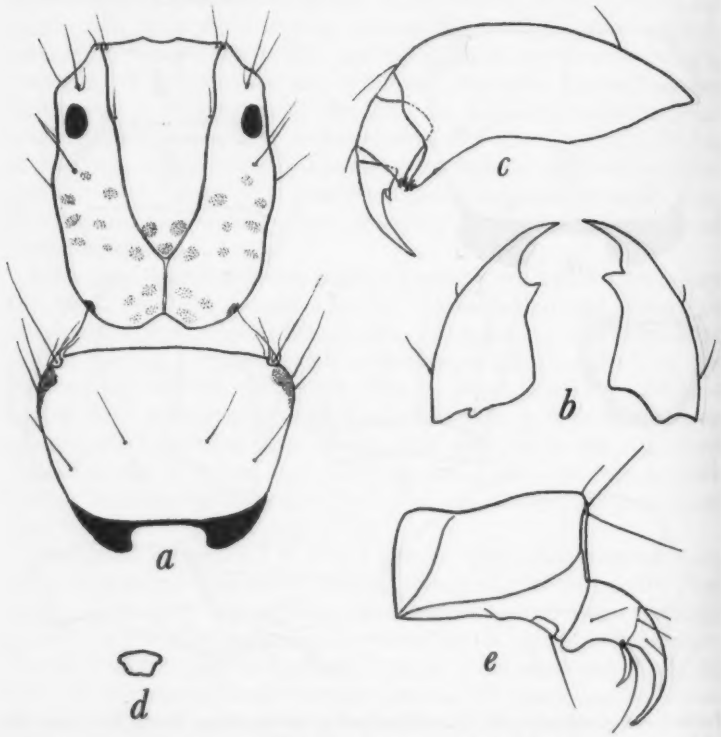

FIGURE 4.—Hydrobiosinae genus A: *a*, larval head and pronotum, dorsal view; *b*, larval mandibles, dorsal; *c*, femur through tarsal claw of larval foreleg, posterior face; *d*, larval prosternum, ventral; *e*, left anal proleg of larva, lateral.

Atopsyche species 3

This larva is very similar to that assigned to *alconura*, but differs in lacking the ventral dark marks on the head.

LARVA.—Length 10 mm. Coloration as in *alconura*, except central stripe on frontoclypeus narrower and no dark marks ventrally.

MATERIAL.—Venezuela: Río Cobre of the Catatumbo system below La Grita, Mar. 31, 1942, L. P. Schultz, 2 larvae (USNM).

Hydrobiosinae genus A

FIGURE 4

In the material from Ecuador are two hydrobiosine larvae that differ in many structural characteristics from the larvae of *Atopsyche*. The most important differences are the fusion of the pronotal halves, the reduction of the prosternite to a minute sclerite, and the disappearance of a segment in the forelegs.

No genus other than *Atopsyche* is known to occur in Ecuador, so I can not even speculate as to the generic placement of these larvae.

LARVA.—Length 6 mm. Head yellowish, muscle scars darker, posterior margin black (fig. 4,*a*). Labrum as in *Atopsyche*. Maxilla about the same, except lateral part of stipes almost completely membranous except at seta and mesal part strongly sclerotized toward base and closely united with cardo. Labium as in *Atopsyche*, except dorsally where mesal strap lacks teeth and hypopharyngeal rods with only 5 or 6 teeth on strongly angulate apical portion. Mandibles with only a single dorsal subapical tooth (fig. 4,*b*). Pronotum yellowish, posterior and lateral margins black; lacking mesal suture (fig. 4,*a*). Prosternum very small (fig. 4,*d*), in width only one-fifth of the distance between legs. Forelegs chelicerate, but femur not twisted; femoral process much narrower than that of *Atopsyche*; apparently tibia and tarsus fused (at least only 1 segment obviously present); claw extending beyond tip of femoral process (fig. 4,*c*). Abdomen generally as in *Atopsyche*. Anal proleg lacking basoventral spine; claw sharply curved ventrad, basal segment with a broad curved spine arising apicoventrally and a normal seta arising laterally at its base (fig. 4,*e*).

MATERIAL.—Ecuador: Stream 5 miles south of Antisana, 13,500 ft., Apr. 28, 1958, R. W. Hodges, 1 larva; stream 11 miles west of Pujili, 12,500 ft., Mar. 15, 1958, R. W. Hodges, 1 larva.

Family Glossosomatidae

The subfamily Glossosomatinae is present in the New World only in the Nearctic region; the Protoptilinae, also widely distributed in North America, is the only subfamily present in the Neotropics.

Eight genera have been recognized for the South and Central American species. The wing venation used here is explained in Ross (1956, figs. 365–367).

Key to Neotropical Genera of Glossosomatidae

1. Wings, especially hind, reduced in size and venation . . **Merionoptila** Schmid
   Wings not reduced 2
2. All four branches of M present in forewing . . . . **Culoptila** Mosely
   Only two or three branches of M present in forewing 3
3. Two branches of M in forewing 4
   Three branches of M in forewing 6
4. Cu_1 branched apically in hindwing . . . . . **Mortoniella** Ulmer
   Cu_1 unbranched in hindwing 5
5. Branching of M in forewing at about same level as branching of R_{4+5}. **Scotiotrichia** Mosely
   M branching much nearer wing margin than R_{4+5} . . . **Mexitrichia** Mosely
6. R_{4+5} branching nearer forewing margin than R_{2+3} . . . . . **Canoptila** Mosely
   R_{4+5} and R_{2+3} branching at nearly same level 7
7. Cu_1 in hindwing branching apically . . . . . **Antoptila** Mosely
   Cu_1 simple . . . . . **Protoptila** Banks

The larvae of the Protoptilinae are very poorly known at present. Ross (1944) has described some particulars of the larva and pupa of *Protoptila lega* Ross, and Flint (1962) the immatures of *Matrioptila jeanae* (Ross). The larvae of *Mortoniella angulata*, *M. apiculata*, *M. hodgesi*, and *Mexitrichia aries* are described herein. The larvae of these species and of *Protoptila alexanderi* Ross differ strikingly from those of the Glossosomatinae in the structure of the anal claw. The larvae of the glossosomatines have one large ventral hook and 1 or 2 dorsal accessory teeth. In the protoptilines the dorsal accessory teeth apparently are divided longitudinally, hence there are 2 or more pairs of accessory teeth, one row on each side of the ventral central hook. In addition to the differences in the anal claw, there are differences between the subfamilies in the apical spurs of the tibiae, the sclerotization of the thoracic notae, and the symmetry of the mandibles.

The larvae appear to show generic differences, although criteria for the separation of the species have yet to be found. The tarsal and anal claws, apical spurs of the tibiae, and ninth tergite show some of the most marked generic differences found so far.

The following key is presented only as a guide to the characters found in the previously mentioned species and will probably require much modification when more species and genera become known.

Key to the Genera of Protoptiline Larvae

1. Tarsal claws trifid; ninth tergite with 3 pairs of setae; 3 pairs of accessory anal teeth . . . . . **Matrioptila** Ross

Tarsal claws with a single apical hook; ninth tergite with 2 pairs of long setae 2

2. Anal claw with 2 pairs of well-developed accessory teeth; seta of tarsal claw short and very broad (fig. 7,*e*) . . . . . **Mortoniella** Ulmer

Anal claw with 3 or more pairs of accessory teeth; seta of tarsal claw normal 3

3. Ninth tergite concave apically; seta of tarsal claw arising from base of cuticular outgrowth (fig. 7,*i*) . . . . . **Mexitrichia** Mosely

Ninth tergite convex apically; seta of tarsal claw arising from posterior face of cuticular outgrowth (fig. 7,*j*) . . . . . **Protoptila** Banks

Genus *Mortoniella* Ulmer

Mortoniella Ulmer, Notes Leyden Mus., vol. 28, pp. 95–97, 1906.

Ulmer described the genotype, *bilineata*, from Ecuador in 1906. Subsequently he added a second species, *albolineata*, from Brazil. The latter, however, was removed from the genus by Mosely in 1939 and placed tentatively in *Antoptila*. Martynov (1912) described *tranquilla* from Peru; however, this description, based on a female and unaccompanied by any illustration, is unrecognizable. Such is the present state of our knowledge of the genus.

In the Cornell University collection is a male specimen from Ecuador that perfectly matches Ulmer's description and figures of the genotype and permits the genitalia to be refigured. A second species present in both the adult and the immature material from Ecuador is congeneric on both genitalic and venational characters. Two additional species of *Mortoniella* are described from pharate adults that agree closely in genitalic structure. *Mexitrichia wygodzinskii* Schmid from Argentina apparently also belongs in *Mortoniella* on genitalic considerations, though Schmid's comments on the venation indicate that Cu_1 in the hindwing is unforked in this species. If Schmid's comments are accurate, *Mexitrichia* Mosely may have to be synonymized with *Mortoniella*, because the genitalic differences alone do not seem to justify a generic separation. Until more species and their venation become known, however, I prefer to regard the two genera as distinct.

Larvae of the three new species described here are known to me. They are all similar, in fact, as yet I can find no specific differences, and they are easily separated from the larvae of the other genera. The structure of the tarsal and anal claws is characteristic. The anal claw has only 2 pairs of accessory teeth, and the seta on the tarsal claw has become greatly modified into a short, broad, thumblike process. It must be admitted, however that *Mexitrichia aries*, on which the larval differences are based, may not be congeneric with the genotype and when larvae of other species in this genus become known these apparent differences may not prove to be valid.

Tentatively then, the genus *Mortoniella* differs from *Mexitrichia* in that: Cu_1 in the hindwing is forked; in the male genitalia the tenth tergum is elongate, the ventral surface of the aedeagus is often sclerotized in the form of paired processes, and there are comparatively simple basoventral processes; in the larvae there are only 2 pairs of accessory teeth on the anal claw, and the seta on the tarsal claw is a short, broad, thumblike process; and in the pupa the distal tooth on the inner margin of the mandibles is long and arises far from the apex.

Mortoniella bilineata Ulmer

FIGURE 5,*a*

Mortoniella bilineata Ulmer, Notes Leyden Mus., vol. 28, pp. 97–98, 1906.

A figure of the lateral aspect of the male genitalia is given from a cleared specimen to supplement the figures of Ulmer. The only difference to be noted is in the tenth tergum which Ulmer shows to be slightly longer and slightly different in shape. Otherwise the genitalia, venation, and coloration are an excellent match with the original description.

MATERIAL.—Ecuador: Huigra, 4500 ft., June 13, 1914, 1 ♂, Parish (CU).

Mortoniella apiculata, new species

FIGURES 5,*b–d*; 6; 7,*a–e*

This species is closely related to *angulata* from which it differs most conspicuously in the expanded apex of the dorsal process of the aedeagus and in the greater proportionate length of the genital capsule.

ADULT.—Length of forewing 5 mm., length of body 4.5 mm. Wings of specimens in alcohol brown, with a pale streak in membrane at anastomosis; venation as shown (fig. 5,*c*). Male genitalia (fig. 5,*b*): Ninth segment almost quadrate in lateral view, very oblique; tenth segment with an elevated basomesal area, extending about half length of lateral arms which are separated by a deep narrow mesal incision (fig. 5,*d*); dorsal process of aedeagus angulate dorsally shortly before apex, apex widened into a thin triangular structure; lateral processes of aedeagus simple, slightly angulate rods extending about two-thirds the length of dorsal process; ventrally to aedeagus a pair of short rods basally and 2 paired processes near midlength, ventralmost pair longer than dorsal pair; venter of aedeagus sclerotized in form of paired spatulate process.

Holotype ♂, allotype, paratype ♀: Ecuador: 1 mile east of Papallacta, Jan. 29, 1958, R. W. Hodges (USNM Type 66018). Additional paratypes: Ecuador: 6 ♂, 4 ♀ pharate adults, Río Papallacta, 1 mile east of Papallacta, Jan. 30, 1958, R. W. Hodges; 1 ♂, 1 ♀ pharate

adults, Río San Carlos, 18 miles northwest of Cotocollao, 8500 ft., May 17, 1958, R. W. Hodges.

LARVA.—Length 5 mm., width 1 mm. Head pale brown, slightly paler around eyes (fig. 6,*a*). Mouth parts as in figures 6,*c*,*d*; sclerites of maxillo-labium too indistinct to permit accurate illustration. Pronotum yellow on anterior third, pale brown posteriorly (fig. 6,*b*). Mesonotum with a brown mesal sclerite, and a pair of more lateral indistinct sclerites: metanotum with a pair of indistinct submesal sclerites (fig. 6,*b*). Seta 1 of mesonotum and metanotum pale, short, and decumbent. Thoracic sternites typical of family. Legs yellowish brown; all legs similar (fig. 6,*e*) except apicoventral seta of tibia of midleg and hindleg not feathered (fig. 6,*f*). Tarsal claws with basal projection small, seta short and greatly enlarged; almost oval (fig. 7,*e*). Abdominal segments 1 and 8 dorsally with 3 pairs

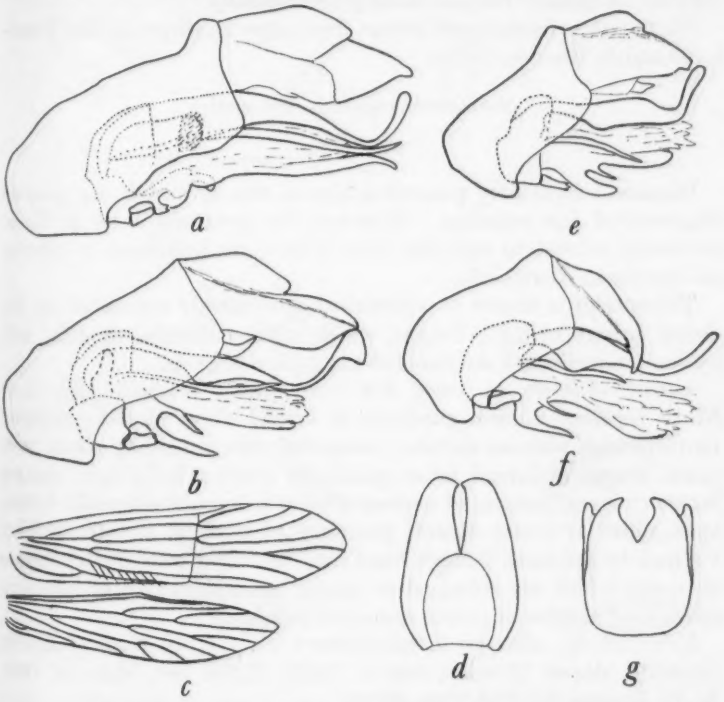

FIGURE 5.—*a*, *Mortoniella bilineata*, lateral view of male genitalia. *b–d*, *Mortoniella apiculata*: *b*, male genitalia, lateral; *c*, venation; *d*, tenth tergum, dorsal; *e*, *Mortoniella angulata*, lateral view of male genitalia. *f*, *g*, *Mortoniella hodgesi*: *f*, male genitalia, lateral; *g*, tenth tergum, dorsal.

of well-developed setae, segments 2–7 with only 2 pairs. Ventrally segments 1 and 2 with 2 pairs of setae, 3–9 with 1 pair. Ninth tergum brown, with 2 pairs of setae. Anal sclerite brown (fig. 6,*h*); claw with 2 pairs of accessory teeth (fig. 6,*g*).

PUPA.—Length 4.5 mm., width 1 mm. Labrum quadrate; apical bristle group with 4 setae, basal with 3 setae. Mandibles identical; inner margin with a strong distal tooth and serrate edge below (fig. 7,*d*). Hook plates anteriorly on segments 2–8 (eighth very small, often absent on females), posteriorly on 4 (fig. 7,*c*). Apex of abdomen without setae.

CASE.—Typically glossosomatid (fig. 7,*a*,*b*). Anterior and posterior ventral openings firmly formed of silk with small embedded sand grains, projecting further ventrad than middle of case. Lateral surface generally formed of 1 larger sand grain. Respiratory openings left irregularly between sand grains dorsally.

MATERIAL.—Larvae and pupae from type localities in Río Papallacta and in Río San Carlos.

Mortoniella angulata, new species

FIGURE 5,*e*

Because I have only pharate adults of this species, I can give no diagnosis of the venation. However, the genitalia show it to be so closely related to *apiculata* that I have no hesitation in placing the species in *Mortoniella*.

The species is closest to *apiculata* but is readily separated by the dorsal process of the aedeagus, which is not expanded apically, and by the proportionate shortness of the genital capsule.

ADULT.—Length of body 3–4 mm. Male genitalia (fig. 5,*e*): Ninth segment almost quadrate in lateral view, slightly oblique; tenth tergum with an elevated basomesal area extending about two-thirds length of lateral lobes which are divided by a deep narrow incision; dorsal process of aedeagus sharply angulate dorsally before apex which is terete, lateral processes of adeagus simple, rodlike; ventrad to aedeagus 2 short basal rods, and near midlength 2 paired processes which are subequal in length; ventral surface of aedeagus sclerotized in form of paired spatulate processes.

Holotype ♂, allotype ♀, paratypes 4 ♂, 1 ♀, all pharate adults: Ecuador: stream 11 miles west of Pujilí, 12,500 feet, Mar. 15, 1958, R. W. Hodges (USNM Type 66019).

LARVA.—Except for their slightly smaller size, no differences found between this species and *apiculata*.

PUPA.—Appears identical to that of *apiculata*.

CASE.—Appears identical to that of *apiculata*.
MATERIAL.—Larvae and pupae from type locality.

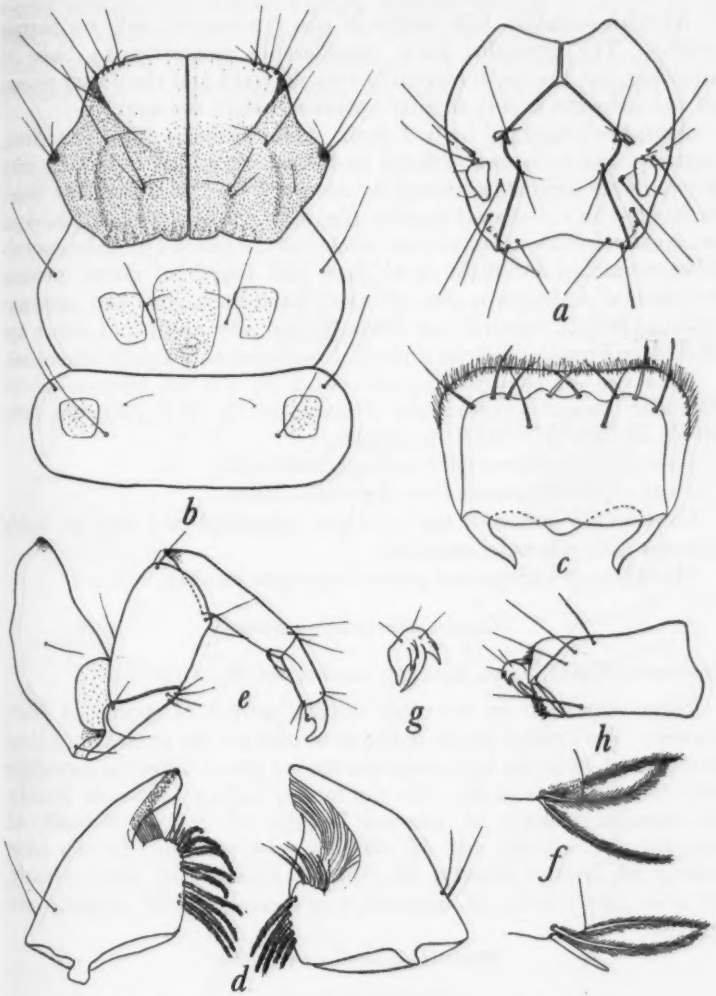

FIGURE 6.—*Mortoniella apiculata: a*, larval head, frontal view; *b*, larval thorax, dorsal; *c*, larval labrum, dorsal; *d*, larval mandibles, dorsal; *e*, larval foreleg, posterior; *f*, (upper figure) apex of tibia of larval foreleg, (bottom) same of midleg; *g*, larval anal claw, posterolateral; *h*, right anal proleg of larva, lateral.

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***Mortoniella hodgesi*, new species**

FIGURE 5,*f*,*g*

As with *angulata*, this species is also represented only by pharate adults. The genitalia show considerable similarity to those of *angulata*, but the tenth tergum is very different and the dorsal process of the aedeagus is only slightly upturned before the apex.

ADULT.—Length of body 4 mm. Male genitalia (fig. 5,*f*): Ninth segment quadrate and oblique in lateral view; tenth tergum with lateral lobes narrow, surpassed by decurved apex of dorsal lobe which is divided by a U-shaped incision (fig. 5,*g*); dorsal process of aedeagus with apex slightly upturned and terete; lateral process of aedeagus rod-like, extending for little more than half length of dorsal process; ventrad to aedeagus a pair of short basal rods, and two processes near midlength, ventral one scoop-shaped and undivided, inner one slender and paired; ventral surface of aedeagus only lightly sclerotized.

Holotype ♂, allotype ♀, paratypes 2 ♂, 2 ♀, all pharate adults: Ecuador: stream 5 miles south of Antisana, 13,500 ft., Apr. 28, 1958, R. W. Hodges (USNM Type 66020).

LARVA.—No differences from *apiculata* found.

PUPA.—No differences from *apiculata* found.

CASE.—The anterior and posterior openings are not as firmly rimmed with silk as in *apiculata*.

MATERIAL.—Larvae and pupae from type locality.

Genus *Mexitrichia* Mosely

Mexitrichia Mosely, Trans. Ent. Soc. London, vol. 86, p. 158, 1937.

There appear to be two very distinct groups of species in *Mexitrichia*. The typical group is characterized by the presence of three branches of M in the hindwing; the second group differs in possessing only two branches of M. To the former belong *M. leroda* Mosely, *M. meralda* Mosely, *M. rancura* Mosely, *M. bolivica* Schmid, *M. wygodzinskii* Schmid, and *M. elongata*, new species. To the latter belong *M. ormina* Mosely, *M. teutonia* Mosely, *M. unota* Mosely, *M. aries*, new species, *M. atenuata*, new species, and *M. aequalis*, new species.

***Mexitrichia aries*, new species**

FIGURES 7,*f*–*i*; 8,*c*

This species apparently is related to *atenuata* and *aequalis*, but may be distinguished by the unique spiral process on the aedeagus.

ADULT.—Length of forewing 3 mm. Brown, membrane at anastomosis pale. Venation apparently the same as that of *atenuata*. Sixth sternum with a long pointed apicomesal process. Male genitalia

(fig. 8,*c*): Ninth segment slightly oblique, anterior margin rounded, posterior straight; tenth tergum almost quadrate laterally, with a ventral process, and cleft on midline dorsally for half its length by a V-shaped incision; dorsal process of aedeagus upturned apically, a ventral straplike process near midlength (in Peruvian specimen this is rounder, and nearly as wide as long); lateral processes not

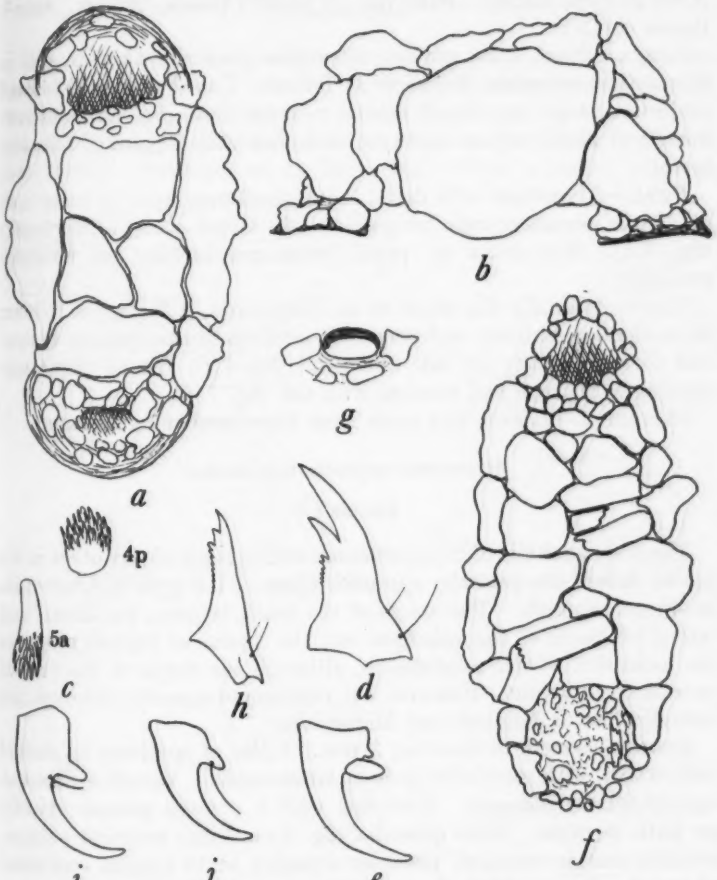

FIGURE 7.—*a–e*, *Mortoniella apiculata: a*, larval case, ventral view; *b*, larval case, lateral; *c*, pupal hook plates, dorsal view of abdominal segments 4, posterior, and 5, anterior; *d*, right pupal mandible, dorsal; *e*, larval tarsal claw, lateral; *f–i*, *Mexitrichia aries: f*, larval case, ventral; *g*, dorsal respiratory opening of larval case, dorsolateral; *h*, right pupal mandible, dorsal; *i*, larval tarsal claw, lateral; *j*, *Protoptila alexanderi*, lateral view of larval tarsal claw.

obviously present; a slender mesal process dorsally on aedeagus; aedeagus with a pair of short rods basally, and 2 pairs of processes near midlength, ventral pair a straight pointed process, lateral pair spiraling dorsally.

Holotype, pharate ♂: Ecuador: Napo-Pastaza Province, Río Chingual, 8 miles east of El Pun, 8000 ft., May 4, 1958, R. W. Hodges (USNM Type 66021). Paratype ♂: Peru: Chosica, 2800 ft., June 9, Parish (MCZ).

LARVA.—None fully grown. Structure generally the same as in *Mortoniella apiculata*, differing as follows: Tarsal claws with basal projection large, seta small arising near its base (fig. 7,*i*); posterior margin of ninth tergum concave; anal claw with 3 pairs of accessory teeth.

PUPA.—Mandibles with distal tooth small near apex of inner margin; inner serrate margin proportionately longer than in *Mortoniella* (fig. 7,*h*). Remainder of pupal structures lacking on specimen available.

CASE.—Basically the same as in *Mortoniella*, differing as follows: More slender; anterior and posterior openings not projecting ventrad and formed loosely of silk and sand (fig. 7,*f*); dorsal respiratory opening cylindrical and rimmed with silk (fig. 7,*g*).

MATERIAL.—Larvae and pupa from type locality in Ecuador.

***Mexitrichia aequalis*, new species**

FIGURE 8,*d*

The male genitalia of this species are unlike those of any other in the genus; indeed the genitalia approach those of the type of *Mortoniella* in several respects. The shape of the tenth tergum, the dorsal and lateral processes of the aedeagus, and the 2 pairs of ventral processes are indicative of this relationship, although the shape of the ventral processes is different. However, the venation of *aequalis*, although not entirely clear, is definitely not *Mortoniella*.

ADULT.—Length of forewing 2 mm. Color of specimen in alcohol pale brown, with membrane pale at anastomosis. Venation about as figured for *M. atenuata*. Abdomen with a pointed process apically on sixth sternum. Male genitalia (fig. 8,*d*): Ninth segment oblique, anterior margin rounded, posterior straight; tenth tergum composed of dorsal and ventral lobes extending posteriorly for the same distance, with a ventral rodlike thickening and posterior margin scalloped; dorsal process of aedeagus of uniform thickness, sharply upcurved before apex, lateral process slender extending as far posteriorly as dorsal process; aedeagus ventrally with a pair of rounded processes basally and 2 pairs of elongate processes near midlength, one pair

arising on midline curving laterally and then posteriorly, the other pair contiguous mesally and extending straight posteriorly.

Holotype ♂: Peru: Río Pichis, Puerto Bermudez, July 17, 1920, Cornell University Expedition lot 569, sub 261 (CU Type 3892).

Mexitrichia atenuata, new species

FIGURE 8,*a–b*

This species seems quite isolated within the genus, but may perhaps be closest to *M. aries*. The pair of slender processes rising laterally on the aedeagus is distinctive.

ADULT.—Length of forewing 3 mm. Color of specimen in alcohol pale brown. Venation as in figure 8,*a*. Sixth sternum with an

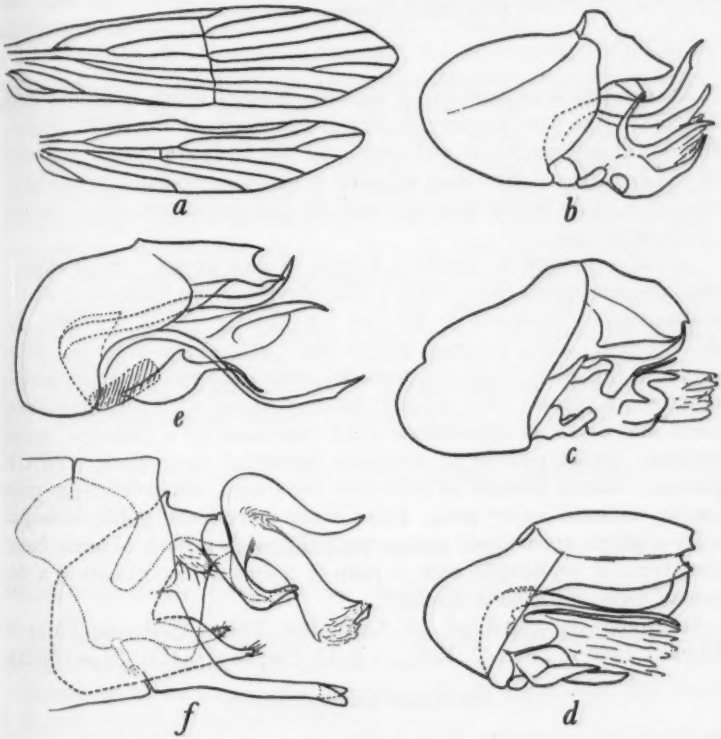

FIGURE 8.—*a*, *b*, *Mexitrichia atenuata: a*, venation; *b*, male genitalia, lateral; *c*, *Mexitrichia aries*, lateral view of male genitalia; *d*, *Mexitrichia aequalis*, lateral view of male genitalia; *e*, *Mexitrichia elongata*, lateral view of male genitalia; *f*, *Protoptila bicornuta*, lateral view of male genitalia.

apicomesal pointed projection. Male genitalia (fig. 8,*b*): Ninth segment almost circular in lateral aspect; tenth tergum declivous, in dorsal aspect broadly and deeply excavate mesally, with lateral flap-like extensions and with a ventromesal projection; dorsal process of aedeagus sharply upcurved from near base, tapering to a sharp point, lateral processes arising near middle of aedeagus and divided into 2 rods, basal one directed more laterally, apical one more posteriorly; aedeagus with a pair of divergent apicomesal spines arising on upper surface; ventrad to aedeagus a pair of short rods basally, and a large structure developed into a pair of slender divergent apical rods.

Holotype ♂, paratypes 14 ♂: Peru: Río Pichis, Puerto Bermudez, July 15, 1920, Cornell University Expedition lot 569, sub 255 (CU Type 3893).

***Mexitrichia elongata*, new species**

FIGURE 8,*e*

M. elongata is related to *M. meralda* Mosely which is known from Mexico. The two are very similar in the shape of the tenth tergum, the dorsal process of the aedeagus, and the elongate lateral processes of the aedeagus. However, *elongata* is easily recognized by the presence of a spine in the aedeagus and by the paired processes ventrad to the aedeagus.

ADULT.—Length of forewing 4 mm. Color brown; wings clothed with golden brown hairs, with a pale streak in the membrane at the anastamosis. Venation is figured by Mosely (1954, fig. 80), for *M. rancura*. Sixth sternum with a short apicomesal process. Male genitalia (fig. 8,*e*): Ninth segment somewhat oblique, anterior margin rounded, posterior very sinuate; tenth tergum with an apicodorsal point and a pair of apicolateral arms separated by a U-shaped mesal incision; dorsal process of aedeagus upturned near apex, which is pointed, lateral process of aedeagus very long, decurved near midlength, widened before apex, with a sharp apicodorsal point; aedeagus with a single apicodorsal spine, ventrally with a dark obscure basal structure, at midlength with a pair of processes each bearing a decurved twisted filament apically.

Holotype ♂, paratype ♂: Colombia: Valle, Tablones, Finca la Florida, 1300 m., Jan. 7, 1959, J. F. G. Clarke (USNM Type 66022).

***Mexitrichia teutonia* Mosely**

Mexitrichia teutonia Mosely, Novitates Zoologicae, vol. 41, p. 223, 1939.

The type locality of this species is Brazil. I have seen additional specimens from Brazil.

MATERIAL.—Brazil: Nova Teutonia, 3 to 500 m., July 1945, 1 ♂; 194?, 1 ♂, 1 ♀, F. Plaumann (USNM). Cordisburgo, Minas Gerais, trap light, November 1919, 1 ♂, 19 ♀ (CU).

Genus *Protoptila* Banks

Protoptila Banks, Proc. Ent. Soc. Washington, vol. 6, p. 215, 1904.

Protoptila bicornuta, new species

FIGURE 8,*f*

The structure of the apical half of the aedeagus is totally unlike any other described species. Because there are no lateral spines on the aedeagus, the species will fall in Mosely's group 2, but differs from the other species in this group in the shape of the process of the eighth sternum and in the structure of the aedeagus.

ADULT.—Length of forewing 3 mm. Wings covered with brown hair, and with an indication of an irrorate pattern of more golden hairs. Sixth sternum with usual blunt apicomesal lobe. Male genitalia (fig. 8,*f*): Almost entirely retracted within eighth segment; eighth sternum produced into a long slender process, bifid for apical fourth; ninth sternum produced into a shallow scoop, with an emarginate apical margin; small ovoid cercus present near base of tenth tergite; tenth tergum divided into lateral decurved lobes, apices divided into internal and external points. Aedeagus complex: Base dorsally with usual halberd-shaped mesal lobe; 2 short rods ventrally near base, beyond these an obscure complex from which 2 hirsute lobes extend; constricted to a very narrow neck below tenth tergum beyond which 3 structures arise, a pair of curving dorsal processes, a central tube with membranous end bearing 2 short spines, and 2 strong ventral hooks.

Holotype ♂: Honduras: Lancetilla, August, Stadelmann (MCZ Type 30410).

Protoptila salta Mosely

Protoptila salta Mosely, Trans. Ent. Soc. London, vol. 86, pp. 154–156, 1937.

Originally described from a series taken in Chiapas, Mexico, the species is now recorded from another nation.

MATERIAL.—Guatemala: Guatemala City, at light, Mar. 29, 1961, 1 ♂, 1 ♀, T. and F. Ruhoff (USNM).

Protoptila cardela Mosely

Protoptila cardela Mosely, Bull. British Mus., Ent. series, vol. 3, no. 9, p. 336, 1954.

Several additional specimens of this species are recorded from the type locality.

MATERIAL.—Mexico: La Gloria, Cardel, Veracruz, January 1933, 2 ♂, 1 ♀; May 1937, 2 ♀, J. Carmelo G. (USNM).

***Protoptila dubitans* Mosely**

Protoptila dubitans Mosely, Novitates Zoologicae, vol. 41, p. 221–222, 1939.

A species originally described from Nova Teutonia, Brazil, that is now recorded from Minas Gerais.

MATERIAL.—Brazil: Cordisburgo, Minas Gerais, November 1919, 4 ♂ (CU).

***Protoptila tojana* Mosely**

Protoptila tojana Mosely, Bull. British Mus., Ent. series, vol. 3, no. 9, pp. 331–333, 1954.

Mosely described the species from 1 ♂ collected in Chiapas, Mexico. In the material from the MCZ are 2 ♂ from Honduras that are identical with Mosely's figures of the type. In addition, a series collected in Lima, Peru, greatly extends the known range of the species. The Peruvian specimens differ in that the tenth tergite has a slender process dorsally to the lateral arms which are sharply angulate near their apices. In the Central American material the dorsal processes are almost completely fused to the lateral arms which are more evenly curved near their apices. These differences, however, are so slight, considering the similarity of the remainder of the genitalia, that I believe they are conspecific.

MATERIAL.—Honduras: Lancetilla, August, 2 ♂, Stadelmann (MCZ). Peru: Lima, July 3, 1914, 1 ♂, 1 ♀ (MCZ); July 8, 1914 (CU); Aug. 20, 1914, 2 ♂, 1 ♀ (MCZ, CU); Aug. 24, 1914, 1 ♂ (MCZ); Aug. 30, 1914, 1 ♀ (MCZ); Aug. 31, 1914, 1 ♂ (CU) (all collected by Parish).

Genus *Antoptila* Mosely

Antoptila Mosely, Novitates Zoologicae, vol. 41, p. 219, 1939.

***Antoptila brasiliana* Mosely**

Antoptila brasiliana Mosely, Novitates Zoologicae, vol. 41, pp. 220–221, 1939.

An additional male from the type locality was seen.

MATERIAL.—Brazil: Nova Teutonia, Aug. 20. 1932, 1 ♂, F. Plaumann (MCZ).

Genus *Scotiotrichia* Mosely

Scotiotrichia Mosely, Trans. Ent. Soc. London, vol. 82, p. 160, 1934.

Scotiotrichia ocreata Mosely

Scotiotrichia ocreata Mosely, Trans. Ent. Soc. London, vol. 82, pp. 160–162, 1934.
Scotiotrichia acreata Schmid, Mitt. Zool. Mus. Berlin, vol. 34, p. 194 (misspelling of *ocreata* Mosely), 1958.

Recently I was able to study a series of this species and discovered that the original figure (Mosely, 1934, fig. 52) of the venation is not correct. The venation shown for the hindwing and the anterior half of the forewing is correct. However, the venation in the forewing posterior to M is not as shown, but is essentially as in figure 8,*a;* that is, Cu_1 arises from M basally and runs free to the wing margin, Cu_2 is also free to the margin, and 1A and 2A are looped together basally.

Material.—Chile: Río Tres Pasos, Magallanes, Dec. 11, 1960, 4 ♂, T. Cekalovic K. (USNM).

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WEEVILS OF THE GENUS MAEMACTES

By David G. Kissinger

Maemactes is a small weevil of the subfamily Cryptorhynchinae whose members are known from southwestern United States, Mexico, Guatemala, and Peru. The biology of the species is unknown, and individuals of the genus are rare in collections; 30 specimens were available to the author for study. This paper presents a key to the species, describes two new forms, and indicates a new synonymy.

The taxonomy of the genera of this subfamily is very difficult. Some characters that will aid in distinguishing *Maemactes* from other cryptorhynchine genera are: pygidium somewhat exposed ventrally in both sexes when abdomen is in a normal position; metepisternum narrow and imperfectly separated from metasternum; sternal crypt extending into mesosternum; sternite 2 longer than sternite 3; claws simple, free; funiculus of antenna seven-segmented; elytra truncate at base and with tenth stria abbreviated; scutellum minute; functional wings lacking; outer margin of tibia at most slightly carinate and not crenulate or toothed.

Genus *Maemactes* Schoenherr

Maemactes Schoenherr, Genera et species curculionidum, vol. 4, p. 276, 1837.—Champion, Biologia Centrali-Americana, Coleoptera, vol. 4, pt. 4, p. 529, 1905. Type of genus: *Maemactes ruficornis* Boheman, by monotypy.

Baropsis LeConte, Proc. Amer. Philos. Soc., vol. 15, no. 96, p. 258, 1876.—Champion, Biologia Centrali-Americana, Coleoptera, vol. 4, pt. 4, p. 529, 1905. New synonymy. Type of genus: *Baropsis cribratus* LeConte, by monotypy.

Champion (1905) questioned the validity of *Baropsis* LeConte but did not synonymize it with *Maemactes*. Comparision of *B. cribratus* LeConte, the type of *Baropsis* by monotypy, with available species of *Maemactes* reveals no significant difference between the genera; in fact it is with some difficulty that *cribratus* is distinguished from some species of *Maemactes*.

M. vestitus Kirsch, from Peru, is included in the following key on the basis of the original description; I have not seen specimens of this species.

Key to Species of *Maemactes*

1. Elytra clothed in part with both erect setae and decumbent scales 2
   Elytra lacking broad scales 3
2. Elytral intervals convex, with black erect setae; suture between sternites 1 and 2 curved at the middle . . . . . **perforatus** Champion
   Elytral intervals flat, with white erect setae; suture between sternites 1 and 2 straight . . . . . **vestitus** Kirsch
3. In dorsal view rostrum at widest point less than three times as wide as frons at narrowest point 4
   In dorsal view rostrum at widest point four or more times as wide as frons at narrowest point . . . . . **cribratus** (LeConte)
4. Punctures of dorsal surface of prothorax coarse, more than 0.12 mm. in diameter, containing a small seta-bearing puncture on one side which has its inner rim projecting into the large puncture; interspaces on prothorax polished and with numerous minute punctures . . . . . **punctatus,** new species
   Punctures on dorsal surface of prothorax smaller, setae arising centrally from bottom of punctures; interspaces on prothorax microreticulate and lacking minute punctures 5
5. Frons wide, in dorsal view rostrum at widest point about one-tenth wider than frons; elytra with obvious (at × 15) erect setae, intervals narrow and convex, striae obvious and complete . . . . . **pilosus** Champion
   In dorsal view rostrum at widest point one-fifth or more wider than frons; elytra lacking obvious erect setae, intervals flat or irregular, striae in part incomplete 6
6. Elytral intervals more or less flat throughout, dull, with dark setae less than 0.06 mm. long; strial punctures evenly spaced; sternite 2 distinctly longer than sternite 5; median lobe of aedeagus of male 0.50 mm. in length (basal struts excluded) . . . . . **ruficornis** Boheman
   Elytral intervals in part convex, polished and shining, with yellowish setae 0.06 to 0.10 mm. long; strial punctures irregularly placed; sternite 2 as long as sternite 5 (in male); median lobe of aedeagus of male 1.25 mm. long (basal struts excluded) . . . . . **imitator,** new species

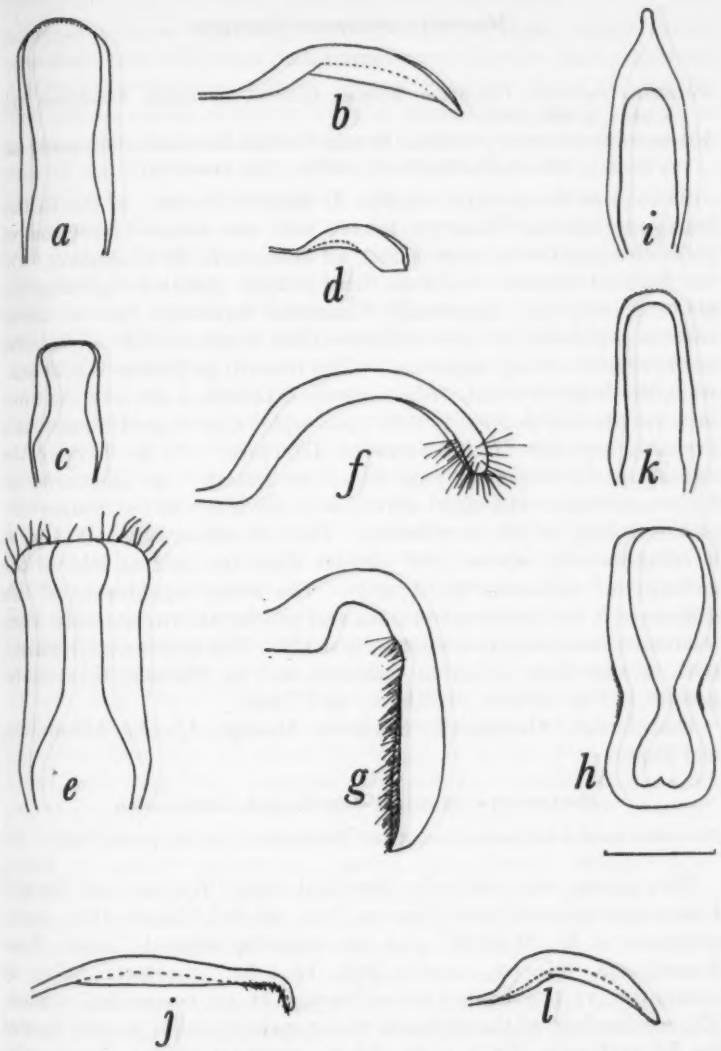

FIGURE 1.—*a–d*, *Maemactes perforatus* Champion: *a*, *c*, dorsal view of median lobe of the aedeagus of the male; *b*, *d*, lateral view of same; *c*, *d*, based on dissection of paratype of *subfasciatus* Champion. *e*, *f*, *M. ruficornis* Boheman: *e*, dorsal view of median lobe of the aedeagus of the male; *f*, lateral view of same. *g*, *h*, *M. imitator*, new species: *g*, lateral view of the median lobe of the aedeagus of the male; *h*, posterior view of same (apex of aedeagus to top of figure). *i*, *j*, *M. punctatus*, new species: *i*, dorsal view of median lobe of the aedeagus of the male; *j*, lateral view of same. *k*, *l*, *M. pilosus* Champion: *k*, dorsal view of median lobe of the aedeagus of the male; *l*, lateral view of same. Line equals 0.50 mm. in all drawings except *e* and *f* where it represents 0.25 mm.

Maemactes perforatus Champion

FIGURE 1,*a–d*

Maemactes perforatus Champion, Biologia Centrali-Americana, Coleoptera, vol. 4, pt. 4, p. 529, 1905.

Maemactes subfasciatus Champion, Biologia Centrali-Americana, Coleoptera, vol. 4, pt. 4, p. 530, pl. 26, figs. 12, 12a, 1905. New synonymy.

Thanks to the kindness of Mr. J. Balfour-Browne, of the British Museum (Natural History), I have seen one abraded specimen of *perforatus* and two of *subfasciatus*, all determined by Champion. On the basis of external structure there is little question regarding the above synonymy. Apparently Champion separated the two forms because *perforatus* has eyes which are close together while *subfasciatus* has eyes more widely separated. The frons of *perforatus* is 0.18 mm. wide, the frons of a male *subfasciatus* is 0.18 mm. wide, and the frons of a female *subfasciatus* is 0.36 mm. wide; thus sexual dimorphism probably accounts for the observed difference. On the basis of the male genitalia the synonymy is not so certain. As illustrated by figure 1, *a–d* there is a slight difference in the shape of the median lobe of the aedeagi of the two forms. That of *subfasciatus* (fig. 1, *c*, *d*) is comparatively shorter and blunter than the median lobe of the aedeagus of *perforatus* (fig. 1, *a*, *b*). The exact significance of this difference is not known at present and can be determined only when a series of dissections is available for study. The forms are sympatric, both having been found at Calderas and at Dueñas, Guatemala. Length, 4.7 to 6.5 mm.; width, 2.2 to 2.7 mm.

Distribution: Guatemala: Calderas, Dueñas, Quiché Mountains, and Zapote.

Maemactes cribratus (LeConte), new combination

Baropsis cribratus LeConte, Proc. Amer. Philos. Soc., vol. 25, p. 259, 1876.

This species was originally described from "Kansas and Texas." I have seen material from Victoria, Tex., labeled "March 1913, under cowchips, J. D. Mitchell" and also material labeled "South West Texas" and "Mexico, tomato fruit, 12–4–52," the latter taken in quarantine at the United States border at an unspecified station. The median lobe of the aedeagus of the male is similar to that figured for *M. perforatus* (fig. 1, *a*, *b*) with the exception that it is not quite as stout in lateral view. Length, 3.7 to 4.5 mm.; width, 1.6 to 2.1 mm.

Maemactes punctatus, new species

FIGURE 1, *i*, *j*

Length, 4.75 to 5.06 mm.; width, 2.18 to 2.43 mm. Rather broadly oblong-ovate; slightly depressed dorsally. Shining black; tarsi and

antennae piceous. Sparsely clothed with suberect, fairly coarse, somewhat yellowish setae. Rostrum stout, shorter than prothorax, depressed throughout, coarsely densely punctate basad of insertion of antennae, distad of this point with sparse fine elongate punctures; in dorsal view ratio of width of frons to widest point at base as 2:5, ratio of width of frons to width of rostrum at antennal insertion as 2:3; in lateral view frons slightly flattened between base of rostrum and head so that rostrum does not merge smoothly with head; head with rather small, deep, moderately close punctures; eye acutely oval, 0.56 mm. from top to bottom, 0.25 mm. wide. Prothorax about as long as wide at base, sides expanding from base to widest point near middle, there nearly one-fifth wider than base, rounded to slightly constricted apex; punctures very deep, very coarse, from 0.12 to 0.18 mm. in diameter, each puncture with a seta arising from its side from a separate small puncture which has its inner wall projecting into the cavity of the large puncture and its outer wall shared with the large puncture; interspaces polished and shining, with sparse minute shallow punctures, interspaces varying in size from cariniform to quite wide, flat areas; no indication of median impunctate area; postocular lobes feebly developed. Elytra 1.7 times as long as prothorax as 12:7; at widest point elytra nearly one-fifth wider than prothorax at widest point as 19:16; widest a little behind basal third; intervals narrow, equal to or slightly wider than striae, all more or less convex, intervals 3 and 5 more prominent, each with a single row of rather large punctures bearing suberect setae, each seta about 0.12 mm. long and mostly linear but a few clavate; punctures separated by about the length of a seta; striae complete, broad, with large deep quadrate punctures and usually with a single row of setae generally smaller than those on intervals, also an irregular lateral row located where stria merges with interval, this row composed of usually narrow to (rarely) quite broad, scalelike setae. Middle femur with a small tooth; hind femur with a distinctly larger tooth; hind tibia mucronate on inner apical angle. Sternites deeply, rather coarsely, and moderately closely punctured; male with sternite 1 broadly shallowly concave medially toward apical margin, with suture between sternites 1 and 2 deep and straight medially, sternite 2 distinctly shorter than sternite 5 when measured medially; female with sternite 1 more convex toward apex, with suture between sternites 1 and 2 shallow and arched medially, sternite 2 equal in length to 5 when measured medially. Median lobe of aedeagus of male as figured.

Holotype male, Finca El Real, Ocosingo Valley, Chiapas, Mexico, July 1–7, 1950, Goodnights and Stannard, from *Andropogon* clump, USNM Type 65803. Allotype, same data as holotype, in author's collection.

This species can be recognized by the peculiar punctation of the prothorax, the narrow frons, the suberect setae, and the distinctive median lobe of the male.

Maemactes pilosus Champion

FIGURE 1, *k*, *l*

Maemactes pilosus Champion, Biologia Centrali-Americana, Coleoptera, vol. 4, pt. 4, p. 529.

This species was originally described from two specimens from Cuernavaca, Mexico. A small series in the California Academy of Sciences is labeled "Maria Madre Island, village, Tres Marias Islands, May 14, 1925, H. H. Keifer"; the islands are located off the coast of Nayarit, Mexico. Mr. R. T. Thompson, of the British Museum (Natural History), kindly compared several specimens with the type. He states that *pilosus* has the surface of the prothorax smooth, with a flat median line; the specimens from Maria Madre Islands have the surface of the prothorax microreticulate and the median line slightly raised. At present I prefer to use one name for both populations.

Length, 5.2 to 6.0 mm.; width, 2.2 to 2.6 mm.

Maemactes ruficornis Boheman

FIGURE 1, *e*, *f*

Maemactes ruficornis Boheman, *in* Schoenherr, Genera et species curculionidum, vol. 4, p. 277, 1837.—Champion, Biologia Centrali-Americana, Coleoptera, vol. 4, pt. 4, p. 529, pl. 26, figs. 11, 11a, 1905.

Known to occur only in Mexico: Capulalpam, Cerro de Plumas, Matamoros, Izucar, Mexico City, "Mineral del Oro," Oaxaca, Puebla, Salazar, Sierra de Durango, Toluca, and Tula.

See discussion of *Maemactes imitator* for characters separating that species from *M. ruficornis*.

Length, 4.7 to 6.5 mm.; width, 2.1 to 2.7 mm.

Maemactes imitator, new species

FIGURE 1, *g*, *h*

Length, 5.43 mm.; width, 2.25 mm. Elongate oval, dark piceous, sparsely clothed with short yellowish setae. Rostrum stout, shorter than prothorax, depressed throughout, basad of insertion of antennae punctures irregular, deep, moderately coarse; distad of same point with moderately dense, elongate, deep punctures; in dorsal view ratio of width of frons to width of rostrum at widest point at base as 1:2, ratio of width of frons to width of rostrum at insertion of antennae as 5:6; in lateral view rostrum evenly merging with head; head with rather small, deep, moderately close punctures; eye acutely oval,

0.42 mm. from top to bottom, 0.25 mm. wide. Prothorax a trifle longer than wide at base as 12:12.5, sides expanding from base to widest point at middle, there one-fifth wider than base; punctures deep, coarse, about 0.06 mm. in diameter, each puncture with seta arising centrally from bottom; interspaces mostly slightly narrower than diameter of punctures, flat, impunctate, with strong microreticulation and with short median line present at center; postocular lobes feebly developed. Elytra 2.3 times as long as prothorax as 30:13, widest in middle third, here about one-fifth wider than prothorax at widest point as 6:5; intervals in part somewhat convex, irregular, mostly wider (except at base) than punctures marking striae, with one or two irregular rows of rather large, deep punctures, about 0.04 to 0.06 mm. in diameter, punctures bearing decumbent setae ranging from 0.06 to 0.10 mm. long; apex of seta may extend past base of next seta, surface of intervals with obscure microreticulation, polished, shining; striae mostly incomplete except at base, with deep coarse punctures irregularly placed, generally closer together in basal and apical quarters, there generally separated by a distance subequal to diameter of punctures; two or three closely adjacent strial punctures may be connected by a short section of a completed stria; toward central region of disc strial punctures much more widely separated by flat intervals on the same level and connected to the adjacent elytral intervals. Middle femur with a small tooth, hind femur with a distinctly larger tooth; hind tibia mucronate on inner apical angle. Sternites deeply, rather coarsely, moderately densely punctured; male with sternites 1 and 2 broadly, shallowly concave medially, suture between sternites 1 and 2 shallow and arched medially, sternite 2 as long as sternite 5 when measured medially. Median lobe of aedeagus of male as figured.

Holotype male, Chilpancingo, Guerrero, Mexico, intercepted in quarantine Aug. 5, 1946, on orchid plants from Chilpancingo at Laredo, Tex., USNM Type 65804.

This species is readily distinguished, on the basis of external characters, from all the species of *Maemactes*, except *ruficornis*, by its lack of both broad scales and suberect setae on the elytra and by the width of the frons. The median lobe of the aedeagus of *imitator*, in both size and shape, differs widely from those of all the other species of *Maemactes*, including *ruficornis*.

The following external characters distinguish *imitator* from *ruficornis*: *imitator* with elytral intervals in part somewhat convex; intervals more or less polished and shining with vague microreticulation and with punctures about 0.04 to 0.06 mm. in diameter, bearing setae 0.06 to 0.10 mm. long, setae yellowish in color and quite obvious in contrast to dark background; strial punctures irregularly placed,

some close together and others widely separated; sternite 2 as long as sternite 5; *ruficornis* with elytral intervals more or less flat throughout (hint of fine striae at extreme base), somewhat "wavy" in appearance but with no definitely raised, convex ridges; intervals with distinct microreticulation and dull, with fine punctures about 0.02 to 0.04 mm. in diameter, bearing setae generally less than 0.06 mm. long, setae dark in color; strial punctures more or less evenly spaced; sternite 2 distinctly longer than sternite 5.

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MOTHS OF THE FAMILY ACROLOPHIDAE IN AMERICA NORTH OF MEXICO (MICROLEPIDOPTERA)

By Frank F. Hasbrouck[1]

Introduction

The Acrolophidae, a family of small to medium moths of predominantly brownish coloration, have no common name and are not of great economic importance in the United States; but the larvae of these moths, sometimes known as "burrowing webworms," attack grasses (including corn), bromeliads, and orchids, usually feeding on the roots. The group has long been in need of a monographic revision.

These insects, presumably limited to the Western Hemisphere, exhibit perhaps a greater affinity toward the Tineidae than toward any other family in North America. The literature referable to the North American segment of this family is not extensive and is largely confined to the original descriptions of genera and species. Accounts of the immature stages of the species are quite rare. Since the appearance of Meyrick's four species in 1919 no new acrolophids have been described from the United States, and the literature has exhibited very little new information of any kind regarding the family.

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As this investigation progressed, it became apparent that not only had few attempts been made to point out the relationships among existing species, but that several entities previously treated as entirely unrelated species were actually very closely related subspecific components of a single complex species, and that other close relationships indicating the presence of small but distinct species groups had apparently passed unnoticed.

It also became apparent that much of the synonymy created by earlier workers was caused by three difficulties: (1) the placing of too much emphasis upon the deceptively variable characters of size and coloration; (2) the failure to utilize the excellent characters furnished by the structures of the head and genitalia; and, (3) the lack of familiarity with previously designated type specimens.

The majority of synonyms referable to the North American Acrolophidae are confined to a relatively small number of species occurring in the eastern United States. These old, widely distributed, and abundant species not only are common in collections but also exhibit considerable variation in size and coloration over their respective geographical ranges.

The present taxonomic framework of the Acrolophidae is based almost exclusively upon the adult males and although this is not the most desirable situation, it will undoubtedly remain the most accessible and practical approach to the classification of this group until considerably more can be learned about the females and various immature stages. Thus, the present revision is likewise based almost entirely upon males, and all of the author's statements describing the structures and relationships exhibited by the various species are referable to the males of those species unless otherwise indicated.

In the majority of collections, the females of most species of Acrolophidae are considerably rarer than the males. The female is unknown in some species and it has been only tentatively associated with the male in others. The females, in common with those of the great majority of families of the Microlepidoptera, possess two sexual openings, one for copulation and one for oviposition.

To the writer's knowledge, no acrolophid has ever been collected in Canada. Nevertheless, a few of our more northern species, such as *morus*, undoubtedly occur at least sparingly in southern Ontario. There is also a noteworthy lack of records of acrolophids from the northwestern portions of the United States. The group becomes progressively more abundant both in species and individuals toward the southern, and especially toward the southwestern, borders of the United States. More species have been reported from Florida than from any of the other eastern States. Many species have been recorded from Texas and a somewhat lesser number from its neighbor, New

Mexico. By far the greatest variety of species has been collected in Arizona, with the majority taken in the southeastern part of that State. The actual center of distribution of the Acrolophidae is probably either Central America or northern South America. The family ranges considerably southward, a number of species having been described from Argentina. Its members also occur on such island groups as the West Indies and the Hawaiian Islands. Several species have been reported to occur on both the mainland and some of these islands. However, there is some question as to whether any two such distantly isolated populations could actually belong to a single species.

When the present revision was begun, the majority of holotypes representing the known North American species of Acrolophidae was about equally divided between the United States National Museum and the British Museum. The latter institution furnished photographs of its type material in sufficient detail to confirm the identity of the species involved. In May 1951 the writer spent nine days at the United States National Museum in order to study firsthand the types there. It was found that 16 of the 28 holotypes at this institution represented valid species, the remaining 12 proving to be synonyms. The writer has been unable to examine the holotypes of 7 species—those of *popeanellus*, *plumifrontellus*, *arcanellus*, *mortipennellus*, *busckellus*, and *agrotipennellus* at the Academy of Natural Sciences in Philadelphia, and of *texanellus* at the Museum of Comparative Zoology—but their identities are reasonably confirmed by information relating to them in the literature. Specimens of the two species, *acanthogonus* and *exaphristus*, regarded here as *incertae sedis*, and of the subspecies, *macrogaster macrogaster*, have not been available to the writer for study.

Of the 22 species and subspecies described as new in this revision, holotypes of 18 have been deposited in the U.S. National Museum. In those four cases where the Museum did not receive the holotype, it was presented with a paratype morphologically equivalent to the holotype in order to make the collection of at least one institution as complete as possible. The many paratypes resulting from this revision have been widely scattered among a number of institutions in the United States. The disposition of these paratypes is noted in the treatment of each new species and subspecies.

The writer wishes to express his indebtedness to Dr. W. V. Balduf, of the Department of Entomology of the University of Illinois, under whose direction this revision was made. He is also most grateful to the following individuals and institutions who have collectively sent on loan the slightly more than 2800 specimens upon which this study was based: R. H. Beamer (University of Kansas, Lawrence); J. C.

Bequaert (Museum of Comparative Zoology, Cambridge, Mass.); Andreas (Andrew) Bolter Collection (recently transferred from Department of Entomology, University of Illinois, to Illinois State Natural History Survey, Urbana); C. S. Brimley (North Carolina Department of Agriculture, Raleigh); A. E. Brower (Augusta, Maine); A. B. Champlain (Bureau of Plant Industry, Department of Agriculture, Harrisburg, Pa.); J. F. Gates Clarke (U.S. National Museum, Washington, D.C.); J. R. Dymond (Royal Ontario Museum of Zoology, Toronto); J. R. Eyer (New Mexico College of Agriculture and Mechanic Arts, State College); W. T. M. Forbes and Henry Dietrich (Cornell University, Ithaca); W. J. Gerhard (Chicago Museum of Natural History); M. O. Glenn (Magnolia, Ill.); H. E. Jaques (Iowa Wesleyan College, Mount Pleasant); A. B. Klots and W. P. Comstock (American Museum of Natural History, New York); J. N. Knull (Ohio State University, Columbus); A. W. Lindsey (Denison University, Granville, Ohio); Clay Lyle (Mississippi Agricultural and Mechanical College, State College); C. E. Mickel (University of Minnesota, St. Paul); H. I. O'Byrne (Glencoe, Mo.); M. A. Palmer (Colorado State College, Fort Collins); E. S. Ross and Mrs. Barbara Prendergast (California Academy of Sciences, San Francisco); H. H. Ross (Illinois State Natural History Survey, Urbana); M. E. Smith (Massachusetts State College, Amherst); D. B. Stallings (Caldwell, Kans.); W. R. Sweadner (Carnegie Museum, Pittsburgh, Pa.); H. D. Tate (University of Nebraska, Lincoln); B. H. Walden (Agricultural Experiment Station, New Haven, Conn.); L. P. Wehrle (Agricultural Experiment Station, Tucson, Ariz.); A. K. Wyatt (Chicago, Ill.). Especially large series were received from the American Museum of Natural History (538 specimens), Cornell University (538 specimens), and the California Academy of Sciences (323 specimens).

The writer wishes to acknowledge the suggestion of the original problem by the late Messrs. Carl Heinrich and August Busck of the U.S. Department of Agriculture. When the writer eventually visited the U.S. National Museum in spring of 1951 to study type specimens, Dr. J. F. Gates Clarke was most helpful in dissecting a number of the types and in offering valuable suggestions regarding several problems that had arisen during the course of work. Mr. W. H. T. Tams, of the Department of Entomology at the British Museum (Natural History), very kindly sent excellent photographs of the type material of the North American Acrolophidae possessed by that institution. These photographs represented both the pinned specimens and slide preparations of their genitalia. Lastly, the writer expresses his thanks to Dr. E. P. Darlington for tabulating and sending a descriptive list of the pertinent types in the collection of the Academy of Natural Sciences of Philadelphia.

History and Status

The history of the North American segment of the family, Acrolophidae, actually began in Cuba well over one hundred years ago. This group was first recognized as distinct from other tineids by Poey (1832–1833), who diagnosed it in his newly erected genus, *Acrolophus*, the genotype of which was his new Cuban species, *A. vitellus*. At that time Poey also recognized the affinities between his species and the tineid *Pinaris hamiferella*, previously described from Rio de Janeiro by Hübner, and he stated that both species evidently belonged to the same genus. However, he was unable to accept Hübner's genus *Pinaris* on the grounds that the majority of its species, as well as Hübner's diagnosis of the genus itself, did not at all agree with his conception of *Acrolophus*. Eventually, *hamiferella* was transferred from *Pinaris* to *Acrolophus* by Walsingham (1887a, p. 154), whose quotation of the original description unquestionably showed it to be an acrolophid.

Clemens (1859–1860) described the first acrolophids from North America. Although he recognized their distinctness, he was unaware of Poey's previous diagnosis of the group, and he erected a new genus of Tineidae, *Anaphora*, for the reception of his three new species. Like Poey, Clemens felt that a generic ranking was sufficient for this group. Grote (1872) became the next contributor by adding two species to Clemens' genus. Zeller (1873) also described two species of *Anaphora*, although both subsequently proved to be synonyms of Clemens' earlier species. Chambers (1878a) described a single species under *Anaphora*. Grote (1881) described one more species under his new generic name, *Eutheca*, believing it to be a new type of psychid.

In 1882, Walsingham made the first of his numerous contributions to this group when he became the first to apply Poey's generic name *Acrolophus* to a North American species, *A. simulatus*, of Texas. At the same time, he erected a new genus, *Eulepiste*, for a second new Texan acrolophid. Two years later, he erected another new genus, *Pseudoconchylis*, for a species which he erroneously placed in the subfamily Conchylinae of the Tortricidae. In 1887, Walsingham published his "Revision of the Genera *Acrolophus* Poey and *Anaphora* Clemens," the first comprehensive review of the group. In this work, he treated not only a number of old and new foreign genera and species but also practically all the North American genera and species known at that time. Walsingham also erected 6 new North American genera and described 11 new North American species in this paper. Most of the latter species still remain valid. Walsingham felt that the group's then numerous genera, including his own, were at that time distinct, although he admitted that "intermediate forms may probably be

found." He also accorded the group subfamily status within the Tineidae, referring to it as the Anaphorinae without explaining why he gave Clemens' *Anaphora* (1859–1860) priority over Poey's original genus *Acrolophus* (1832–1833).

Beutenmüller (1887–1888) described four species and a varietal form under *Acrolophus*. All but one of these subsequently proved to be synonyms of older species. In 1891 Walsingham, in a paper on the Microlepidoptera of the West Indies, continued the usage of the subfamily name Anaphorinae. In the same year, Smith in his checklist became the first worker to give the group family status as the Anaphoridae. Like his predecessors Smith failed to give any reasons for his particular ranking, and he also perpetuated Walsingham's error in giving *Anaphora* priority over *Acrolophus*. Walsingham (1897), in a revisional study of the West Indian Microlepidoptera, maintained his category, Anaphorinae, and erected a new West Indian genus, *Atopocera*, which was later applied to a North American species by Dyar.

Following a 10-year period which saw little work done on North American acrolophids, Dyar (1900–1903) described eight species and one subspecies under almost as many different generic names of previous authors. He erroneously placed one of these species in *Phalonia*, a genus of the Phaloniidae. In October 1900 Dyar stated his opinion that the group could hardly be recognized as a family, and that its genera should fall in more naturally with those of the Tineidae. It is to be noted that he followed this plan in his list of 1903. However, in November 1900 Dyar used the subfamily ranking in his title, "New Species of Anaphorinae." Holland (1903) followed Dyar's views in listing the various acrolophid genera among those of the Tineidae. Kearfott (1907) described one acrolophid under *Amydria* (now *Myrmecozela*), a closely related genus in the Tineidae. In the same year, Walsingham described his last North American species in this group under *Homonymus*, a genus he had erected in 1887 for the reception of a species from Argentina.

Busck (1907–1912) described as new six North American species. His first was placed under Walsingham's genus, *Neolophus*, erected in 1887, and it was referred to by Busck as an "anaphorid." However, following the description of his second species in 1910, Busck stated:

> I am unable to retain as distinct the several genera erected on the secondary sexual characters of the various forms of palpi in this group. This view is shared by Lord Walsingham and Mr. Durrant, and will be further elaborated in their forthcoming part of Dr. Godman's Biologia Centrali-Americana.

This and all of Busck's subsequent species were described under *Acrolophus*. In May 1912 Busck apparently became the first to use

the family name, Acrolophidae when, following the description of a new species of *Acrolophus*, he stated:

> The various genera, erected in the family Acrolophidae on the secondary sexual characters of the labial palpi can not be maintained.

Busck again used this family name in September 1912 in his title, "Two New Californian Acrolophidae." By this time, it had apparently been decided by Busck, Walsingham, Durrant, and probably by others among their co-workers that the various genera referable to the group should all be combined under the original genus *Acrolophus*, which should in turn be given family rank as Acrolophidae.

A short time later, Meyrick (1913), in a paper describing new species of South American Microlepidoptera, briefly expressed his opinion of the situation by combining the 16 genera of this group known to him under the single genus *Acrolophus* in the following statement (pp. 191–192):

> *Acrolophus*, Poey—I unite under this name *Anaphora* Clem., *Bazira* Walk., *Eddara* Walk., *Urbara* Walk., *Eutheca* Grote, and Walsingham's genera *Atopocera*, *Ankistrophorus*, *Caenogenes*, *Eulepiste*, *Felderia*, *Hypoclopus*, *Neolophus*, *Ortholophus*, *Pilanaphora*, *Pseudanaphora*, and *Thysanoscelis*, all of which are in my judgment based on characters which are in this genus of specific value only, and indeed in part unreliable even for that. I may add that I treat the generic name as feminine, which is permissible, regarding it as a Greek compound adjective of two terminations, that is, with the masculine and feminine forms identical. I regard the uncus as always double, though the two parts are sometimes closely appressed.

It should be noted that *Bazira*, *Eddara*, *Urbara*, *Caenogenes*, *Pilanaphora*, and *Thysanoscelis* were not referable to North American species. Apparently, Meyrick was not aware that the homonymous name *Eutheca* had been replaced by *Sapinella* Kirby in 1892, and that the homonymous name *Ankistrophorus* had been replaced by *Homonymus* Walsingham in 1887. He apparently was also unaware that the genus *Pseudoconchylis* Walsingham was referable to this group instead of to the Tortricidae. Although Meyrick's reasons for uniting these genera were sound, his conception of the uncus was quite arbitrary and certainly faulty. In many species this organ is obviously single with no indication whatsoever that it is formed from two parts either closely appressed or even fused. Lastly, Meyrick's grammatical treatment of the generic name *Acrolophus* is open to considerable question. In his lexicon Woods (1924) treats it as masculine; and in the present revision the name is considered to be masculine and singular.

In 1913 Barnes and McDunnough described three new species under three of Walsingham's old genera. They also adhered to his subfamily Anaphorinae. And in 1914–1915, Walsingham, Durrant, and Busck saw published their "Tineina of Central America" in the "Biologia Centrali-Americana." This represented Walsingham's last major work on the group in question, and, as the title implied,

the material treated was almost exclusively Central American. However, all the decisions regarding the Acrolophidae previously reached by this group of workers were set down in their statements prefatory to the volume. The failure of the old generic characters was discussed at considerable length, and twenty different genera formerly applied to the group were combined into the one large genus *Acrolophus*. The latter along with two salvaged monotypical genera, neither of North American origin, presumably constituted the family, Acrolophidae. These two genera, *Apoclisis* and *Urbara*, are perhaps now also synonyms of *Acrolophus*, leaving the Acrolophidae a monogeneric family. Although Walsingham and his co-workers gave this group family status without justifying that ranking beyond referring to it as "this very distinctly recognisable family," it has since been generally considered as a family, especially by North American workers.

Haimbach (1915) described a single North American species, since found to be a synonym, under Clemens' old genus, *Anaphora*. In 1917, Barnes and McDunnough in their listing of North American Lepidoptera placed all the known species of the group in the genus *Acrolophus*, under the family Acrolophidae. Meyrick (1919) described as new four North American species, placing them under *Acrolophus*. This author continued to recognize the group only as a large genus of the Tineidae. During the many years subsequent to Meyrick's descriptions of 1919 no new North American acrolophids have been described.

Forbes (1923), one of the first workers to diagnose the group with a fairly detailed and accurate discussion of not only adult but also larval and pupal characters, gave it subfamily ranking as the Acrolophinae on an equal status with the Tineinae, in the family Tineidae. However, he stated: "The two subfamilies are not closely related, and could well be treated as families, as they often are." He did not consider the group to be monogeneric for, without elaboration, he said: "Besides *Acrolophus* there are a couple of other well-defined genera." Forbes' general diagnosis, which did not include genital characters, is now somewhat in need of revision.

Eyer (1924), who made a study of the comparative morphology of the male genitalia of primitive Lepidoptera, accorded the group family status as the Acrolophidae, and he apparently became the first worker to diagnose and place the group on the basis of the male genitalia. Although previous workers, notably Walsingham in 1887, had used these organs for the separation of species, and had described and illustrated them, Eyer was the first to use them collectively for comparison with allied groups. From an examination of 9 North American, 1 Panamanian, and 1 Peruvian species of Acrolophidae, he

concluded that their genitalia most closely resembled those of two genera in the Tineidae, *Scardia* and *Amydria* (now *Myrmecozela*). His examination also supported the earlier combination of all the various genera under the original genus *Acrolophus*. As in the case of Forbes' work, Eyer's diagnosis of acrolophid genitalia now needs some revision. In 1926, Eyer published on characters of family and superfamily significance in the male genitalia of Microlepidoptera, and he again gave the group in question family ranking. However, his genital diagnosis of the Acrolophidae, based largely upon the results of his study of 1924, also included two tineid groups, Amydriinae and Scardiinae.

Comstock, in his general textbook, "An Introduction to Entomology" (1924, and subsequent editions published after his death), followed the general trend in considering the group a family. His diagnosis of the Acrolophidae partially followed that of Forbes, with some change and reduction of information. McDunnough (1939), in his check list of North American Microlepidoptera, listed 46 species, 1 form, and 6 synonyms of Acrolophidae, all under the genus *Acrolophus*. He placed this family between the Psychidae and Tineidae in the superfamily Tineoidea. Costa Lima (1945), in his volume on Brazilian Lepidoptera, considered the group a family, but he erroneously attributed the original usage of Acrolophidae as a family name to "Dyar (1901)." Hinton (1950, personal correspondence through Dr. J. F. Gates Clarke), who was formerly at the British Museum (Natural History) and who has done considerable work on Microlepidoptera, regards the acrolophids as no more than a subfamily of the Tineidae.

It is apparent from the foregoing historical review that there is at present some disagreement among lepidopterists as to whether this group should receive family, subfamily, or simply generic ranking. In the more than one hundred years since Poey erected the genus *Acrolophus*, the numerous workers publishing on the group have given it various rankings, but they have usually failed to include any structural characters to justify those rankings. The taxonomy of adult acrolophids is far from perfect and even less is known about the immature stages and the biology of the group in general. Also, the information on most of the related groups is imperfect in varying degrees. At the present time, the subfamily category has been entirely dispensed with in the North American Tineoidea, and it is very doubtful that a future majority of workers would ever return the acrolophids to the generic level. However, no attempt is made here to justify the family ranking, Acrolophidae, except to say that as such it more conveniently fits into the present and widely accepted classification of North American Tineoidea as set forth by McDunnough (1939).

Taxonomic Considerations

For many years, one of the major systematic problems within the Acrolophidae has been the apparent lack of generic characters. The family is fairly large now and eventually, when the many undescribed species existing in Mexico, Central America, and South America have been accounted for, it will undoubtedly embrace some hundreds of species. It is reasonable to assume that such a large assemblage of species should fall naturally into a number of fairly distinct genera. In addition, for the purely practical reasons of preparing keys and separating the species, it is obvious that the worker, for his own convenience, would very much like to subdivide this assemblage of species into a series of smaller and more easily handled groups or genera. Although the writer has kept these facts in mind throughout the course of the present revision, he has not been able to find any positive generic characters in the Acrolophidae. At best, he has been able to show the existence of a number of small but distinct species groups which at present may be regarded as potential genera.

In separating a group of species into a number of genera, any one genus may be based either upon a single character or upon a group of characters. The Acrolophidae show an annoying resistance to both these lines of approach. The compound eye serves as a good example of the difficulties involved in selecting a single character for generic separation: in some species the eye is entirely naked while in others it is densely setose. Between these two extremes are found well-defined gradations of setosity, each exhibited in a consistent manner by one or more species, with the individuals of any one species having exactly the same amount and type of vestiture upon the compound eye. However, it is possible to take from these same species a series of specimens that exhibits a very gradual and subtle transition of the compound eye from complete nakedness to a very heavily setose condition. Thus, at the generic level, this character is intergrading and must be abandoned.

Exactly the same situation occurs with the labial palpi, which on many species are greatly elongated, while on others they are considerably shortened. With the genital structures the worker fares no better. The uncus is strongly bifurcate in some species while it consists of a single, hooklike process in others; likewise, the gnathos is strongly paired in some species and fused in others, but it will exhibit all degrees of transition between these two extremes through a series of specimens properly chosen from a number of different species.

The venation of the wings offers neither specific nor generic characters. In view of the fact that the arrangement of the veins may be quite dissimilar in the right and left wings of a single specimen, any consideration of venation has been abandoned in the present revision.

In selecting a group or combination of characters for generic separation of the Acrolophidae, there is found a singular failure of any one character to reinforce consistently any other character among the acrolophids. For example, elongate labial palpi and setose compound eyes usually may be associated with one another. In general, as the palpi become longer the eyes become more heavily setose, and, conversely, as the palpi become shorter the eyes become more sparsely setose. However, several species exhibit the combination of greatly elongated labial palpi and naked compound eyes, while several others exhibit a combination of shortened palpi and densely setose eyes. Thus, the combination of eye and palpus must be discarded as a generic character.

The same situation exists among the genital organs. Generally, the bifurcate uncus is associated with the paired gnathos, the simple uncus with the fused gnathos, and both organs tend to show a like amount of fusion or separation in any one species. However, at least one species exhibits the combination of a simple uncus and a strongly paired gnathos. Conversely, another species exhibits a bifurcate uncus and a fused gnathos. Thus, the morphological changes of these two organs from species to species are not always in harmony, and the combination of uncus and gnathos fails to afford a means of generic separation. Cephalic and genital structures may likewise be compared without success. The setose compound eye may commonly be associated with a bifurcate uncus and a paired gnathos, and the short labial palpus is most commonly associated with the simple uncus and the fused gnathos, but to each there are notable exceptions. When four or more characters are used in combination in an attempt to make a generic separation the situation simply becomes more complex and muddled.

From these observations it is apparent that at the generic level any single character becomes an intergrading character, and any number of characters in combination, fail to reinforce one another. But, although every possible proposal for separating the Acrolophidae into two or more genera is met with "exceptions to the rule," this situation provides the worker with a wealth of excellent, nonintergrading characters for the separation of the numerous species.

When all of the species of Acrolophidae have finally been diagnosed and placed in proper sequence, natural genera will undoubtedly emerge from such nuclei as the species groups described in this revision, and they will be based upon rather subtle combinations of numerous characters. To diagnose and assign limits to these genera once their specific components have been found and set into place, will be much easier and also much wiser than to set up arbitrary, and probably faulty, generic categories now, in the hope that subsequently dis-

covered species will fall automatically and smoothly into such categories.

Of the 48 species of *Acrolophus* treated in this revision, 27 may be segregated into a total of 11 natural species groups. The members of any one group are morphologically much more similar to one another than they are to the remaining members of the genus. These species groups cannot be correctly construed as being representatives of genera until the many described and undescribed acrolophids occurring in Mexico, Central America, and South America have been thoroughly diagnosed; at present, it is obvious that at best they may be considered potential genera. The groups of related acrolophids occurring in America north of Mexico are:

1. *simulatus-acornus-bicornutus*
2. *popeanellus-klotsi*
3. *arizonellus-luriei*
4. *cressoni-maculifer-crescentellus*
5. *piger-vanduzeei*
6. *kearfotti-pseudohirsutus*
7. *furcatus-punctellus*
8. *macrogaster* (complex)-*baldufi*
9. *persimplex-fervidus-sinclairi* (complex)
10. *davisellus-serratus*
11. *variabilis-seculatus-macrophallus-mauriei*

The remaining 21 species treated here do not show sufficient relationship with any other acrolophids occurring north of Mexico to warrant their inclusion in species groups. Eventually, however, some of these isolated species will undoubtedly go into combination with other species from Mexico, Central America, and South America to form additional species groups. These unrelated or isolated species are:

1. *dorsimaculus*
2. *griseus* (complex)
3. *texanellus*
4. *exaphristus* (position uncertain)
5. *filicicornis*
6. *plumifrontellus*
7. *mortipennellus*
8. *acanthogonus* (position uncertain)
9. *propinquus*
10. *cockerelli*
11. *pyramellus*
12. *laticapitanus* (complex)
13. *arcanellus*
14. *morus*
15. *forbesi*
16. *panamae*
17. *juxtatus*
18. *chiricahuae*
19. *quadrellus*
20. *minor*
21. *parvipalpus*

Of the species treated here 44 are simple and 4 are complex, and these latter may be subdivided into a total of 13 subspecific components as follows:

1. *griseus* (two)
2. *macrogaster* (four)
3. *laticapitanus* (five)
4. *sinclairi* (two)

Characters of the Family and Genus

The genus, *Acrolophus*, based upon a single Cuban specimen, was described in Professor Felipe Poey's "Centurie de lépidoptères de l'île de Cuba." Written in French and Latin, it contains 20 colored plates and is quite rare in library collections. Although the section on *Acrolophus* is dated "July 1832," the actual date of publication of the entire work in Paris was probably sometime in 1833.

The plate accompanying Poey's description of *Acrolophus* and *A. vitellus* contains three figures: the first, an enlargement of the right forewing of the male, is denuded to show a type of neuration in which the "apical vein" is not forked; the second figure, representing in natural size the adult male in dorsal aspect, shows the overall expanse of the wings to be about 20 mm.; the third, an enlargement of the head, thorax, and legs of the male in right lateral aspect, illustrates the elongated and recurved labial palpi.

It should be noted that in his lexicon, Woods (1944) defines the word *Acrolophus* as "a mountain ridge," a considerably different meaning than that given to it by Poey. Poey's description, translated from the French and Latin text, is as follows:

Acrolophus vitellus, Poey

Characters of the Genus

[Latin] No tongue, antennae simple; palpi very long, recurved, extending past the tergum; all segments barbed up to the apex; anal fringes long.

[French] Genus *Acrolophus*, Poey.—Lacking a distinct tongue, antennae simple, palpi very long, lying on the back, with all the segments barbed up to the extremity; long fringe toward the anal angle.

Characters of the Species

[Latin] Wing luteo-fuscous, forewing with small black spots, costa punctated with black.

[Remainder of article from the French] *Acrolophus vitellus*.—Wings of a yellow brown; the forewings covered with small black spots, more distinct on the costa.

Description

See, on the adjoining plate, the male natural size, the same with the large palpi and legs; and a forewing denuded of its scales, in order to show all the veins; the examination of the discoidal cell shows us that there is still a lot to learn in the study of this character, especially in the smallest species. The latter has the prothorax tomentose and the head placed very low toward the breast. The underside is entirely brown.

Observations

On the genus.—The Greek word ἀχρόλοφος signifies *that which carries a plume to the extremity*; I have made use of it in order to show that the palpi are covered with elongated scales up to the extremity; it is in this that they differ from those

of the ordinary tineids, which have the palpi bent back into a horn and ending in a point. The lack of a tongue distinguishes this species from the Noctuidae and the Tortricidae; in the same manner as the shape, the simple antennae, and especially the length of the fringe of the hindwings, separate it from *Bombyx*; it is allied, by this character and by several others, to the family Tineidae, among which I will place it in the methodical table which will be published at the end of this work.

On the species.—The tineid *hamiferella*, Hüb., Zutr. 441–2, evidently belongs to the same genus; I have two other species of them, which are in too bad a state to describe. For Hübner it is the genus *Pinaris*, which I would have willingly adopted if it had been based on the palpi, and not on the colors of the insect: one is able to see by his Catalogue of the known Lepidoptera, that the majority of his *Pinaris* have short palpi of ordinary form.

HISTORY

I have only taken this species a single time; from which I conclude that it is rare, at least it is difficult to find it during the day; that is why I have not been able to study its habits. The name *vitellus* has been suggested to me by the position of the head, which resembles that of a menacing bull; if it is permissible to compare an almost imperceptible creature with an animal so corpulent.

July 1832.

Fifty-five years later, Walsingham (1887a, p. 154) transferred the questionable *hamiferella* from *Pinaris* to *Acrolophus*.

It is apparent that the characters of the genus *Acrolophus* as set down by Poey in 1832 certainly do not all hold true for many of the species now considered as belonging to that genus. His six generic characters may be evaluated as follows:

(1) "No tongue." Apparently true for all species.

(2) "Antennae simple." Frequent exceptions to this condition occur among the North American acrolophids, which exhibit a number of markedly different antennal types, including well-developed bipectination.

(3) "Palpi very long." Applicable to somewhat less than half of the North American species.

(4) "Palpi recurved, lying on the back, and extending past the tergum." Not true for the many species having shortened labial palpi.

(5) "Palpi with all the segments barbed up to the apex." Although true, the value of such a character is questionable; the labial palpi are completely clothed with scales in many groups of Lepidoptera.

(6) "Anal fringes long." Also true, but again a character of questionable value; the adjective "long" is subject to a rather wide range of interpretation, and the anal fringes are relatively long in many groups of the Lepidoptera.

Since the family is here considered to consist of but a single genus at present, both the Acrolophidae and *Acrolophus* may be treated as one

in regard to their characterization. The definition of the group, based here only upon those species occurring in America north of Mexico, is necessarily incomplete.

The Acrolophidae constitute one of the more primitive families of the nonaculeate Tineoidea. The species are distinctly frenate, the frenulum of the male being a single, large bristle and that of the female being divided into a number of smaller bristles. The basal segment of the antenna is never enlarged or modified to form an eye-cap. In the males, the basal segment of the labial palpus is relatively very large in comparison to that exhibited by allied families. In the male acrolophids, this segment is normally upcurved to the middle of the front.

Many of the species are large, robust moths resembling noctuids. Others are small, fragile, and somewhat tortricid-like. The wing expanse may range from about 10 mm. in the males of some of the smallest species to about 40 mm. in the females of the largest species. Both of these limits are quite easily exceeded when the many tropical species are taken into consideration. In any one species, the females are noticeably larger than the males. However, in a large series of any one species, the largest male is commonly larger than the smallest female. The coloration in both sexes is predominantly brown. Different shades of this color may be variously combined with smaller amounts of white, yellow, gray, black, and red. The color pattern in any one species is generally quite variable, and the pattern of the female tends to be less distinct or more suffused than that of the male. A few species exhibit a rather marked dimorphism in color between the two sexes.

The head is retracted. The vestiture of the head, labial palpi, and maxillary palpi is rough and very dense, consisting largely of scales and spatulate hair. The ocelli are absent. The compound eyes are medium-sized to rather large and they may be naked to very densely setose in both sexes. In any one species, the eyes of the male and the female exhibit approximately the same amount of vestiture. The antenna has a somewhat globular scape. The antennal shaft is smoothly covered on the dorsal surface with at least two rows of scales to a segment. The lateral and ventral surfaces of the antenna are finely pubescent with sensory hairs commonly overlaid with additional scales. The antennae of the males may be simple to strongly bipectinated, while those of the females are always simple and relatively more slender. The mouthparts are wanting in both sexes, the maxillae being simply fused into a small plate bearing a pair of minute, 2-segmented maxillary palpi. This structure and its palpi are normally covered by the much larger, upcurved labial palpi.

The labial palpi, from which the generic name has been drawn, are large, 3-segmented, and without bristles. In the males, these structures may be elongated and recurved back over the head and the dorsum of the thorax to the extent that they reach the first abdominal segment. In such cases, when the palpus is denuded of its vestiture, the basal segment is never the longest of the three. The labial palpi of the males may also be quite short, in which event the denuded basal segment is always the longest of the three. In some species, this basal segment is as long as, or even longer than, the other two segments combined. Although the palpi of the males are always upcurved, they may or may not be closely appressed to the head and thorax. In any one species, the labial palpi of the female are always shorter than those of the male. However, in those species in which the males have considerably shortened palpi, those of the females are only slightly shorter. In other species, the palpi of the females are much shorter than those of the males. In still other species, the palpi of the females are considerably elongated. The labial palpi of the females may be upcurved, porrect, or drooping, but they are never recurved back over the head and thorax.

The thorax is prominently tufted anteriorly and posteriorly, the vestiture being rough, deep, and very dense like that of the head and palpi. In regard to the legs, the femora are similarly clothed, while the hind tibiae are hairy rather than bristled. Forbes (1923, p. 25, fig. 19) has figured and labeled in detail the neuration of the right wings of a typical male acrolophid, *A. popeanellus*, stressing the fact that vein R_5 of the forewing extends to the outer margin. In this group, the neuration seems to furnish little in the way of generic or specific characters. Comstock (1924, p. 611) briefly described the venation as follows:

> The venation of the wings is quite generalized; the base of media is more or less preserved, and all the branches of the branched veins are present; there are three anal veins in both fore and hind wings; in the fore wings the tip of the third anal vein coalesces with the second anal vein.

The abdomen is thickly covered with spatulate scales. In some species, these scales are rather densely overlaid with elongate hairs. In any one species, the abdomen of the female is longer, thicker, and more distended than that of the male. In the males of some species, secondary sexual characters are exhibited in the form of large tufts of scales or elongate hairs arising from the terminal abdominal segments. Except for the genital segments, the abdomen offers little in the way of generic or specific characters. The female has two genital openings, one for oviposition and one for copulation. The latter is surrounded by a ventral genital plate near the tip of the abdomen. The form of this large, heavily sclerotized plate may be used for the separation

of certain species. Normally, the genitalia of the male are partially extruded from the tip of the abdomen.

The male genitalia are of a primitive type similar to those of the Tineidae. The uncus may terminate in a single process, it may be a strongly bifurcated organ, or it may represent any one of a fairly complete series of transitional forms between these two extreme conditions. Likewise, the incomplete gnathos may be paired or fused, with a series of intermediate forms. The harpes are large and commonly spoon-shaped. The cucullus of the harpe rarely bears a clasper, while the costa bears a large, dorsal process in several species. The transtilla is incomplete, consisting simply of a pair of slender arms attached to the harpes. The aedeagus is rather large and normally somewhat expanded or bulblike at the base. It has a large, eversible vesica which commonly bears one to many cornuti. The anellus is typically membranous and unarmed. Rarely, it is partially sclerotized or furnished with minute, spinelike processes. The juxta is normally absent, although it is present in a rudimentary or reduced form in a few species. The vinculum is a simple, U-shaped pouch serving as a base of attachment for the various genital organs. The major genital structures commonly occurring in other groups of Lepidoptera but lacking in the Acrolophidae are the paired socii, the saccus of the vinculum, the clasper of the harpe, the central bridge of the transtilla, the median ventral plate of the gnathos, and the juxta or medioventral plate of the anellus.

The larva, called the "burrowing web-worm," has been characterized by Forbes (1923, p. 119) as follows:

> Larva with front reaching only halfway to vertex, the adfrontals very wide and reaching vertex; ocelli six, but not regularly arranged, the fourth and lower being much closer together than the second and third are; head ventrally chitinized behind labium. Leg with trochanter one-third as wide as femur; prothoracic legs separated by a distinct, chitinized sternum; thorax with setae on large shields; tubercles iii to v apparently taking the place of pleural sclerites; cervical shield extending the whole width of the prothorax and enclosing the spiracle; prolegs with one complete ellipse of hooks, preceded by several (3–6) rows of rudimentary ones; the anal proleg with a curved band.

The larval habits of several species occurring in Illinois have been described by Comstock (1924, p. 611). His description, partially drawn from the observations of Forbes (1905), is as follows:

> The larvae normally live in the ground feeding on the roots of grass. Each larva makes a tubular web opening at the surface and leading down into a vertical cylindrical burrow about the diameter of a lead-pencil, and six inches to two feet, or even more in depth. The larva measures about 25 mm. in length. Sometimes the larvae injure young corn when planted on sod. They surround the base of each plant with a fine web mixed with earth and pellets, building this up in the lower blades, which they slowly eat away. As they get larger they eat the stripped plant to the ground. When disturbed they retreat into their web-lined burrows.

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Pupation occurs in the larval tube in the soil. Forbes (1923, p. 119) has characterized the pupa as being heavily sclerotized, suited for coming up through the earth, and having the antenna shorter than the bluntly rounded forewing. The eggs are oval and strongly ridged.

The Head

The cephalic structures of the male are deserving of special consideration in view of the fact that they are second only to the male genital organs in furnishing not only good specific characters but also potential generic characters. Although the labial palpi, compound eyes, and antennae are easily observable in pinned specimens, the taxonomic value of the form and vestiture of these structures has been commonly overlooked by previous workers in this family. Only the reduced maxillary palpi apparently fail to offer taxonomic characters below the family level. Identical form and vestiture of the labial palpi, compound eyes, and antennae in either the male or the female are consistently exhibited by all of the individuals in any one species or subspecies. In some cases, these similarities are common to the members of a species group, in which event the cephalic structures assume potential generic value.

THE LABIAL PALPI

The writer has spent considerable time studying the relative lengths of the segments in the denuded labial palpi of the males of the various species of Acrolophidae. The males of the North American species of *Acrolophus* can be morphologically, although probably not phylogenetically, separated into two distinct groups on the basis of the relative segmental lengths of their labial palpi. Approximately one-third of the species have greatly elongated palpi recurving back over the head and extending across much or all of the dorsum of the thorax; in these the basal segment is never the longest of the three segments. The majority of species exhibit palpi which are short or, in some cases, intermediate in length; in these the basal segment is always the longest of the three segments.

In those species having the elongate palpi, the heavy and often plumose vestiture almost invariably obscures not only the points of articulation between the segments but also the apical limits of these organs. Thus, the palpus must be denuded in order to ascertain the relative lengths of its segments. The basal segment is always large and recurved back against a considerable portion of the head. This curvature makes accurate measurement of its length quite difficult and any figures obtained for this segment should at best be considered as approximations. The central and apical segments are rarely linear, commonly sublinear, or occasionally somewhat curved,

depending upon the species involved. However, their lengths may always be obtained with reasonable accuracy.

Several conditions may be established for those species exhibiting elongate labial palpi: first, the segments never become progressively shorter from the basal to the apical; second, the basal segment is never demonstrably the longest of the three segments and typically is somewhat to considerably shorter than the central segment; third, when it is occasionally as long as or rarely longer than the central segment, then it is always somewhat to considerably shorter than the apical segment. Since the basal segment is quite large in all species of *Acrolophus*, it is apparent from the above conditions that those species having the unusually long palpi have attained them through a relatively marked elongation of the central and apical segments.

Also, a variety of combinations of segmental lengths occur among those species having elongate labial palpi. The basal segment may be much shorter than (*mortipennellus*), about as long as (*macrogaster laminicornus*), or much longer than (*dorsimaculus*) the central segment. Likewise, the basal segment may be much shorter than (*plumifrontellus*), about as long as (*propinquus*), or much longer than (*luriei*) the apical segment. Further, the central segment may be much shorter than (*plumifrontellus*), about as long as (*popeanellus*), or much longer than (*arizonellus*) the apical segment. Intermediate ratios occur among these major combinations, and the relative segmental lengths may also vary slightly among the individuals of one species.

The denuded segments of the labial palpi are normally tubular or cylindrical in form. However, in *griseus griseus* the central segment becomes progressively laterally flattened distad, appearing very broad in lateral aspect and very narrow in dorsal aspect, while the apical segment is even more markedly laterally flattened. In several species, the apical portion of the apical segment is very slender and attenuated. Those species having elongate palpi typically have setose compound eyes, although *griseus* and *dorsimaculus* are two notable exceptions.

In those species having labial palpi short or intermediate in length, the vestiture obscures the segmentation less, and in some the segmental lengths may be approximated without removing the scales. The basal segment is again large, but it may or may not be closely appressed to and recurved against the head. The central and apical segments may be linear, sublinear, or somewhat curved.

The short and intermediate types of labial palpi exhibit a simpler and more consistent segmental condition than does the elongate type. The segments invariably become progressively shorter from the basal to the apical. Typically, the basal segment is considerably longer

than the central segment, although rarely it is only slightly longer (*macrophallus*). Its length may be less than, equal to, or greater than the combined lengths of the central and apical segments. The central segment may be slightly to considerably longer than the apical segment. In some species having short palpi, the apical segment is extremely short.

In *arcanellus*, a species exhibiting an intermediate type of palpi in which these organs recurve back over the head and extend partially onto the dorsum of the thorax, the relative lengths of the denuded segments are nine for the basal, seven for the central, and five for the apical. However, with its long scales included, this apical segment has a relative length of approximately ten, illustrating how the elongate terminal vestiture may increase the apparent length of the labial palpi. There is no morphological distinction between the short and the intermediate types of palpi, and some transitional forms occur. However, most species not having elongate palpi fall into the one type or the other, and the types are used here as a matter of convenience. Palpi of intermediate length are to some extent associated with setose compound eyes. Short palpi are normally associated with naked eyes, although there are a number of exceptions.

Among the species of *Acrolophus* the vestiture of the labial palpi ranges from rather sparse to very dense, short to elongate, and fairly smooth to rough or somewhat tufted. The scales themselves vary from very slender and hairlike to very broad and spatulate, with both types commonly occurring in one species. The slender scales are typically simple, while the spatulate scales may have their apices simple, bifid, or trifid. The scales are variously colored, and a single scale may exhibit two or three different colors. In such cases, these colors may blend gradually into one another, or each may be rather sharply limited to a definite portion of the scale.

THE COMPOUND EYES

Unlike the labial palpi and antennae, the compound eyes exhibit almost identical form and vestiture in both the male and female of any one species. The eyes vary from fairly large and prominent (protruding) to medium-sized and partially concealed (retracted). Typically circular, they are somewhat elliptical in some species; and like those of the majority of nocturnal moths, they possess many facets. Many species have lashed eyes, with bristles or lashes, which arise around the edge of the eye and curve over it, and are commonly concentrated along the anterior and posterior margins of the eye, although the entire eye may be surrounded by them. The prominent, anterior tuft of lashes in both sexes of *arcanellus* furnishes an excel-

lent character for the identification of that species. The eyes of some species are quite heavily lashed, while those of others are entirely without lashes.

In many species, minute hairs or setae arise between the facets of the compound eyes. Although these setae may be short or long, they are invariably very slender and delicate; in pinned specimens, they are extremely brittle and may easily be broken off. The setae are normally erect and linear, although they are recurved and recumbent in the *cressoni-maculifer-crescentellus* species group. The compound eye may be very densely setose or entirely naked. It may exhibit any of a number of transitional forms between these two extremes, depending upon the particular species selected for study. The eyes of several species exhibit a very sparse scattering of extremely minute setae. Setose eyes are normally associated with elongate labial palpi, but there are a number of exceptions. As a rule, naked eyes are associated with palpi which are short or intermediate in length. Typically, the setose eye is associated with the bifurcate uncus and the naked eye with the simple or undivided uncus, although there are a number of exceptions in both cases.

THE ANTENNAE

The general structure of the antennae in the Acrolophidae has been described in the foregoing characterization of the group. The simplest type of antenna, exhibited by many species, is that in which the segments are short and robust with a globular or beadlike appearance. A somewhat more complex type, also exhibited by a number of species, is a laminate antenna in which each segment has a ventral, quadrangular extension that appears flattened and platelike in lateral aspect. The most complex type of antenna, occurring in several species, is the bipectinate type in which each segment bears two separate processes that arise independently from the antennal shaft and extend lateroventrad. These processes are quite large and prominent, having a tendency to enlarge toward their apices.

Between these simplest and most complex types of antennae, a number of intermediate or transitional forms occur among the acrolophids. Described in detail in the key and in the sections treating the various species, the major types of these are (1) simple or globose, (2) laterally flattened or laminate, (3) transitional between laminate and unipectinate, (4) reduced unipectinate, (5) strongly unipectinate, (6) showing moderate tendency toward bipectination, (7) reduced bipectinate, and (8) strongly bipectinate.

On the antennae of all species, on the dorsal portion of each segment, are at least two rows of scales that overlap to furnish the antennal

shaft with a continuous covering, and on the antennae of many species is a complete ring of scales encircling each segment; about 90 percent of the smaller North American species of *Acrolophus* have this complete ring of scales on each antennal segment. Segments clothed with scales in this manner are almost invariably of the simple or globose type, although a striking exception is the completely scaled but unipectinate antenna of *A. texanellus*, and in the subspecies *laticapitanus laticapitanus* each antennal segment is furnished with two complete rings of scales. Normally, this complete ring of scales is wanting in the larger species and in those having complex types of antennae; such species commonly have an incomplete ring in which the scales extend partly onto the lateral surfaces of the antenna.

The minute setae or sensory hairs are quite short in the simple forms of antennae, although they tend to become elongated on those segments bearing complex processes such as occur in the unipectinate and bipectinate forms. The form and vestiture of the antennae are consistent throughout the members of the *cressoni-maculifer-crucentellus* species group. Thus, in this case, the antenna assumes potential generic value. Conversely, antennal forms are only of subspecific value in the complex species, *macrogaster* and *sinclairi*.

MALE GENITALIA

Although there is still some disagreement among lepidopterists as to the origins and limits of certain genital structures, especially the tegumen, a rather generally accepted concept of their morphology and homology throughout the different families now exists. Likewise, there has developed a group of terms widely used in the description of these structures.

Pierce, in his pioneering works on British Noctuidae (1909) and British Geometridae (1914), contributed much to the present knowledge of the morphology and terminology of lepidopterous genitalia. Although earlier workers, such as Buchanan-White, Gosse, Smith, and Baker, had described and named some genital parts, Pierce was probably the first to make a really detailed taxonomic study of the entire male genital apparatus of many species and genera of moths. He not only formulated a fairly complete set of names for these structures but also was one of the first workers to stress the great value of the aedeagus and its associated organs for the separation of species. Busck and Heinrich (1921), in their paper on the systematic importance of the male genitalia of Microlepidoptera, drew heavily from Pierce's system of nomenclature and concept of morphology. Subsequently, they applied their somewhat modified system in the description of the genitalia of numerous new species of North American Microlepidoptera. Eyer (1924) published on the comparative

morphology of the male genitalia of the primitive Lepidoptera, basing his system largely upon the works mentioned above, but adding much to the knowledge of the morphology and homology of these structures.

While the present revision introduces no new terms or concepts, it is of some interest to note the author of each term and the date he gave it the approximate morphological definition presently accepted, as follows: Buchanan-White (1876), tegumen; Gosse (1883), uncus; Smith (1890), harpes, clasper (of sacculus of harpe); Baker (1891), saccus; Pierce (1909), vinculum, aedeagus, vesica, cornuti, sacculus of harpe, cucullus of harpe; Pierce (1914), anellus, juxta, manica, costa of harpe, valvula of harpe, costal arm or process (of harpe), transtilla, socii, gnathos; and, Busck and Heinrich (1921), penis. Several of these structures are of importance because of their reduction or complete absence in the Acrolophidae. Although the works of Buchanan-White (1876), Gosse (1883), Smith (1890), and Baker (1891) are not cited in the present revision, reference has been made to these workers by Eyer (1924).

In the following characterization, the concepts of the above workers, especially those of Busck and Heinrich, have been combined, condensed, and modified so as to apply specifically to the North American Acrolophidae. Except for the penis and its associated structures, the parts discussed below are generally considered as belonging to the external genitalia. Only the ninth and tenth abdominal segments are involved in the structure of the external genitalia. The eighth segment does not exhibit any genital modification and the presence of an eleventh segment is not indicated. Although the exact defining limits of the ninth and tenth segments are not determinable, it has been indicated that the sclerotized structures surrounding the genital opening (i.e., the vinculum, anellus, aedeagus, harpe, and transtilla) are developments of sclerites of the ninth segment, while the sclerotized structures surrounding the anal opening (i.e., the uncus and gnathos) are developed from the tenth segment.

The vinculum (VN, fig. 5), a modification of the ninth sternum, is a ventral, sclerotized, U-shaped pouch articulating at its dorsal extremities with the tegumen and serving as a base of attachment for the genital capsule. The saccus, a medioventral anterior projection of the vinculum, is absent.

The anellus (AN, fig. 2) is normally an undifferentiated, unsclerotized, unarmed membrane situated within the ventral angle of the vinculum and supporting the aedeagus which it surrounds in the form of a cone. In a few species, it is partially sclerotized; in several others, it is densely clothed with minute, seta-like processes. The juxta

(JX, fig. 2), the ventral plate of the anellus, is normally absent. It occurs in a reduced or rudimentary form in several species.

The manica (MA, fig. 2) is the eversible, membranous sheath of the aedeagus. In the Acrolophidae, it encloses most of the unopened portion of the aedeagus, articulating with both the aedeagus and the anellus. Since the manica is unsclerotized, unarmed, and rather obscure in the members of this family, it offers no character of taxonomic value and it is not mentioned elsewhere in this revision.

The aedeagus (AD, figs. 2, 6) is a sclerotized tube supported by the membrane (anellus) of the ninth segment. Its base is normally somewhat expanded or bulblike, and it may be simple or prolonged into one or more spinelike processes at the apex. It may be glabrous or armed with toothlike projections or spines. This rigid cylinder serves as a protective armature and guide for the membranous penis (PN, figs. 2, 6), an internal genital structure. Although the penis lies within and for part of its length is connected with the aedeagus, this soft and flexible tube can be projected by blood pressure far beyond the mouth of the aedeagus itself. This eversible portion of the penis is called the vesica (VS, figs. 2, 6), and it serves to introduce the sperms into the bursa copulatrix of the female. It is commonly armed with one to a variety of spines, the cornuti (CN, figs. 2, 6), whose relative constancy of size, shape, and number within each species is of great taxonomic value for the separation of species.

The harpes (fig. 1 and HP in figs. 5–6) are paired, lateral, clasping organs attached to the vinculum and articulated with the anellus. These symmetrical, flattened, roughly spoon-shaped structures are subject to considerable modification of form among the various species, thus furnishing very good specific taxonomic characters. The harpe can be roughly differentiated into three areas: a dorsal or costal area, the costa (CS, fig. 1); a ventral area, the sacculus (SC, fig. 1); and, an apical area, the cucullus (CU, fig. 1) or valvula. Normally, these are simply defined by areas of heavier sclerotization, inward foldings, and the location of setae (PS, figs. 1, 5). Any one of these major areas may be developed at the expense of the others. Rarely, the costa is developed into a free extended arm, the costal arm or costal process (CP, fig. 1), forming a double harpe structure. The sacculus is never developed into a clasper. However, a clasper (CL, fig. 1) does occur rarely on the inner surface of the cucullus.

The transtilla (TR, fig. 1) is reduced, broken in the middle, and occurs as a pair of free, glabrous, well sclerotized arms suspended from the inner costal angles of the harpes. These arms, which are somewhat variable within any one species, are not of much taxonomic value in separating the species.

The uncus (UN, figs. 3–6) is the posterior, dorsal projection of the genitalia above the anal opening. It is heavily sclerotized, normally hooklike, and it may be naked or setose. It may be simple, terminating caudad in an uncal process (UP, fig. 3), or it may exhibit varying degrees of bifurcation and terminate in a pair of furcae (UF, fig. 4). The form of the uncus is peculiar to certain species and to a few species groups.

The socii, paired organs lateral to the anal opening, are entirely absent in all acrolophids.

The gnathos (GN, figs. 3–6), an organ ventral to the anus, arises from an area near the base of the uncus. Its median ventral plate may be considered absent, or at least it is not differentiated as a distinct part. It may be simple, occurring as a fused and well sclerotized structure (fig. 3), or it may exhibit varying degrees of bifurcation into a pair of lateral arms (LAGN, fig. 4). As in the case of the uncus, the form of the gnathos is peculiar to certain species and species groups. In some species having the fused gnathos, the apical portion of this organ is clothed ventrad with numerous, minute, seta-like processes which may have a sensory function during copulation.

The tegumen (TG, figs. 3–6) is actually the remaining external covering of the ninth and tenth segments which has not been differentiated into the foregoing parts and from which these parts originate as specialized sclerite structures. However, the entire sclerotized portion of the tegumen is considered to be a part of the tenth segment (i. e., the tenth tergum), the ninth segment being greatly reduced and continued dorsad as a membrane only. The sclerotized part of the tegumen articulates at its lower extremities with the vinculum and from it arise the uncus and gnathos. In the present revision, the lateral extensions of the tegumen are called lateral arms (LATG, figs. 3, 5–6).

In a number of species, there is no clear line of demarcation separating the heavily sclerotized aedeagus from the membranous, eversible vesica. In such cases, between these two structures there is a transitional area exhibiting a gradual change in degree of sclerotization. In some species, such as *A. filicicornis*, where this area of transition is armed, it may be difficult to determine whether such armature belongs to the aedeagus (as spines) or to the vesica (as cornuti). When fluid is forced into a genital capsule which has been softened by treatment in potassium hydroxide, the vesica is commonly caused to expand and reveal the true origin of such processes. In a few species, however, it has not been possible to ascertain satisfactorily whether these processes are spines or cornuti. In such cases, they are simply considered as armature of the transitional area.

It has been observed in numerous dissections that when the vesica of a prepared specimen is extruded by forcing alcohol or water into it, the relative location and direction of its cornuti may be considerably altered. This may be caused not only by the general expansion of the entire vesica but also by the unequal expansion of areas differing in degree of sclerotization. Thus, the armature of the unexpanded vesica of a specimen simply cleared in potassium hydroxide may present a quite different appearance from that of a similar specimen whose vesica has been fully expanded by the application of fluid pressure. Because of this, the location and direction of the cornuti should be considered as variable or secondary characters in comparison to their less variable or primary characters of number, size, and structure. The drawings in this revision were made from alcoholic specimens in which sufficient fluid pressure had been applied to the base of the abdomen to cause the entire genital capsule to extrude.

It has been pointed out by Busck (1931, p. 206) and others that the males in some of the groups of Microlepidoptera possess deciduous cornuti. These are loosely attached to the vesica of the penis which, in many species, is extended through the entire length of the ductus bursae and into the bursa copulatrix of the female during copulation. When the vesica is withdrawn after insemination, these cornuti are left with the spermatozoa in the bursa. Busck states that "these deciduous spines are normally flattened, very sharply pointed, and often nearly as long as the diameter of the female bursa." They are to be distinguished from the fixed cornuti which are firmly attached to the vesica and are withdrawn along with the penis after copulation.

Since the armature of the vesica has been given considerable weight in the present separation and characterization of the various species of Acrolophidae, it has been necessary to make certain that the cornuti are of the taxonomically reliable fixed type. All of the writer's studies of genitalia in this family have indicated the presence of this fixed type, a few dissections having shown only slight evidence of the possible occurrence of the deciduous type. Preparations of the vesicae of both very fresh (probably virginal) and very worn (probably nonvirginal) specimens of any one species have invariably exhibited essentially the same armature. In addition, this armature, whether in the form of very large or very small cornuti, has always been found to be quite firmly attached to the vesica, even after thorough clearing in potassium hydroxide. Lastly, various degrees of increased sclerotization have been frequently observed in those areas of the vesica receiving the bases of the cornuti. Minor variations of this armature among specimens of any one species, as well as the occasional appearance of an additional cornutus or sclerotized structure in the vesica, may be reasonably attributed to intraspecific variation.

In *Acrolophus*, fortunately, the genitalia of pinned specimens usually extrude to an extent permitting identification to species. When the terminal vestiture of the abdomen is removed with a fine brush, several genital structures usually may be observed. The uncus is almost always visible and it may be seen in both dorsal and lateral aspects. The gnathos, beneath the uncus, is often visible. Both of these structures are useful in diagnosing species groups and occasionally even species. The cucullus, representing the approximate apical half of the harpe, is almost invariably extruded. This structure is second only to the aedeagus in furnishing specific characters. The uncus, gnathos, and cucullus are well sclerotized and usually appear about the same in dried specimens as they do after having been cleared in potassium hydroxide. The apical portion of the aedeagus is only occasionally extruded in dried specimens, although it regularly appears in such species as *variabilis* and *macrophallus* where the aedeagus is greatly elongated. In most dried specimens, however, the aedeagus is somewhat distorted through the shriveled condition of its membranous vesica. Thus, it may be seen that many of the references to the genitalia in the key may be utilized without the necessity of clearing and dissecting the specimen beforehand.

Key to the Species and Subspecies of *Acrolophus*

(Based on males)

1. Labial palpi greatly elongated, recurved back over head and extending across much of all of thorax; when denuded, with basal segment never the longest of the three segments 2
   Labial palpi (a) intermediate in length, recurved back over head but extending only slightly onto anterior margin of thorax; or (b) short, only slightly to partly recurved back over head and not extending to anterior margin of thorax; but in either case, when denuded, with basal segment always the longest of the three segments 20
2. Eyes naked 3
   Eyes setose 5
3. Antennae strongly bipectinate . . . . . **1. dorsimaculus** (Dyar)
   Antennae simple, laminate (*griseus*) 4
4. Cucullus of harpe with major portion broadly expanded, with only approximate basal third considerably narrowed (fig. 30).
   2a. griseus griseus (Walsingham), new combination
   Cucullus of harpe with only approximate apical third broadly expanded, with approximate basal two-thirds considerably narrowed (fig. 35).
   2b. griseus capitatus, new subspecies
5. Each antennal segment completely encircled by ring of scales 6
   Each antennal segment clothed only dorsad or dorsolaterad with scales, or antennal segments complex and their processes free of scales 9
6. Antennae unipectinate; uncus bifid (fig. 36) . . **3. texanellus** (Chambers)
   Antennal segments simple, globose; uncus with single process minutely and acutely bifid at extreme apex (figs. 41, 42, 48); (*simulatus-acornus-bicornutus* species group) 7

7. Cucullus of harpe with apical portion broadly expanded (fig. 39); vesica of aedeagus unarmed (fig. 40) . . . . . **4. acornus,** new species
Cucullus of harpe with apical portion not broadly expanded (figs. 43, 46); vesica of aedeagus armed with cornuti (figs. 45, 47) 8
8. Cucullus of harpe with approximate central third moderately expanded ventrad (fig. 43); vesica of aedeagus armed with approximately 6 to 12 small cornuti (figs. 44, 45) . . . . . **5. simulatus** Walsingham
Cucullus of harpe not expanded ventrad (fig. 46); vesica of aedeagus armed with 2 large cornuti (fig. 47) . . . . . **7. bicornutus,** new species
9. Antennae strongly bipectinate 10
Antennae unipectinate or laminate 11
10. Forewing with prominent, irregular, white patch in basal half; furcae of uncus subparallel to slightly convergent, with distance between apices much less than length of each furca (fig. 87); harpe with base of cucullus broad and indistinctly merging with costa and sacculus (figs. 83, 85); vesica of aedeagus unarmed (figs. 84, 86) 16
Forewing without white patch; furcae of uncus divergent, with distance between apices at least equal to length of each furca; harpe with base of cucullus narrowed and separated from costa and sacculus by ventral constriction (fig. 49); vesica of aedeagus armed with numerous, small cornuti (figs. 52, 53) . . . . . **8. filicicornis** (Walsingham)
11. Harpe with long, prominent costal process overlapping cucullus (figs. 54, 58). **9. plumifrontellus** (Clemens)
Harpe without costal process 12
12. Furcae of uncus with bases broadly separated and developed ventrad into pair of prominent, semicircular plates with dentate margins; furcae with major portions convergent and overlapping distad, with apical portions flattened dorsoventrad and divergent (figs. 61, 62, 63) . **10. mortipennellus** (Grote)
Furcae of uncus not as above 13
13. Furcae of uncus abruptly directed or curved very strongly ventrad through angle of approximately 90 degrees (figs. 8, 9, 69); vesica of aedeagus armed with either one large cornutus (fig. 66) or two large clusters of cornuti (figs. 10, 11, 12); (*popeanellus-klotsi* species group) 14
Furcae of uncus not curving strongly ventrad (figs. 70, 98); vesica of aedeagus either unarmed (figs. 79, 84, 86, 101) or armed with very small cornuti not arranged in clusters (fig. 97) 15
14. Furcae of uncus abruptly directed ventrad, broadly expanded and flattened in lateral aspect (figs. 9, 16, 17); vesica of aedeagus armed with two large clusters of cornuti (figs. 11, 12) . . . . . **11. popeanellus** (Clemens)
Furcae of uncus curving strongly ventrad, unexpanded and only slightly flattened in lateral aspect (fig. 69); vesica of aedeagus armed with one large cornutus (fig. 66) . . . . . **13. klotsi,** new species
15. Furcae of uncus tubular, divergent, with distance between apices approximately equal to length of each furca (figs. 74, 75); eastern species: Missouri, Arkansas, and eastward . . . . . **14. propinquus** (Walsingham)
Furcae of uncus somewhat flattened laterad, subparallel, with distance between apices much less than length of each furca (figs. 87, 99); southwestern species: Texas, New Mexico, and Arizona 16
16. Harpe rather slender, with base of cucullus narrowed and separated from costa and sacculus by dorsal and ventral constrictions (figs. 95, 100); forewing without prominent white patch in basal half; (*arizonellus-luriei* species group) 19

Harpe broad, with base of cucullus broad and indistinctly merging with costa and sacculus (figs. 83, 85); forewing with prominent, irregular, white patch in basal half; (*macrogaster*, in part). [See couplet 38 for species-group relationship] 17

17. Antennae bipectinate, with pectinations wider at bases than outwardly.
15a. macrogaster macrogaster (Walsingham), new combination

Antennae unipectinate or laminate 18

18. Antennae unipectinate; process of each antennal segment not laterally flattened, separated from adjacent process by space at least equal to its own thickness . . . . . **15c. macrogaster unipectinicornus,** new subspecies

Antennae simple, laminate; process of each antennal segment laterally flattened, separated from adjacent process by narrow space much less than its own thickness . . . **15d. macrogaster laminicornus,** new subspecies

19. Sacculus of harpe with ventrocaudal extremity strongly angulated (fig. 95); vesica of aedeagus armed with single row of 10 to 15 minute cornuti (fig. 97) . . . . . **17. arizonellus** Walsingham

Sacculus of harpe with ventrocaudal extremity not angulated (fig. 100); vesica of aedeagus unarmed (fig. 101) . . . . . **18. luriei,** new species

20. Each antennal segment completely encircled by at least one ring of scales; mostly smaller species, wing expanse usually less than 21 mm. 21

Each antennal segment clothed only dorsad or dorsolaterad with scales, or antennal segments complex and their processes free of scales; mostly larger species, wing expanse usually greater than 21 mm. 37

21. Eyes obviously setose 22

Eyes naked or very sparsely and obscurely scattered with exceedingly minute setae 26

22. Eyes rather sparsely clothed with recumbent or partially recurved setae; rings of antennal scales small, widely separated, directed considerably outward and resembling small funnels; forewings with small patches of upraised scales; uncus with single process minutely and acutely bifid at extreme apex (figs. 105, 106); vesica of aedeagus unarmed (figs. 104, 107, 111); (*cressoni-maculifer-crescentellus* species group) 23

Eyes rather densely clothed with erect setae; rings of antennal scales large, narrowly separated or overlapping, not funnel-shaped; forewings without patches of upraised scales; uncus bifid (figs. 116, 117, 121); vesica of aedeagus armed with cornuti (figs. 114, 115, 119, 120); (*piger-vanduzeei* species group) 25

23. Cucullus of harpe broadest in central portion, with apical portion narrowed (fig. 102); aedeagus curving through angle of approximately 180 degrees (fig. 103), with apex acute in lateral aspect (figs. 103, 104).
19. maculifer (Walsingham)

Cucullus of harpe not broadest in central portion, with apical portion slightly expanded and broadly rounded (figs. 108, 109, 110); aedeagus curving through angle of approximately 90 degrees or less, with apex narrowly rounded in lateral aspect (figs. 107, 111) 24

24. Cucullus of harpe linear or sublinear (figs. 108, 109); aedeagus curving through angle of approximately 90 degrees, with base expanded ventrad into large flaplike process curving back upon itself (fig. 107).
20. cressoni (Walsingham)

Cucullus of harpe with major apical portion curving considerably dorsad (fig. 110); aedeagus with major central portion sublinear and with only basal and apical extremities somewhat curved, with base not expanded into flaplike process (fig. 111) . . . . . **21. crescentellus** (Kearfott)

25. Cucullus of harpe fairly evenly expanded beyond base to present subsymmetrically capitate appearance (fig. 112), costa of harpe with considerable dorsal expansion caudad of point of attachment of arm of transtilla (fig. 112); vesica of aedeagus armed along dextral margin with irregular row of approximately 18 minute, weakly sclerotized, indistinct cornuti unequal in size (figs. 114, 115); wing expanse approximately 16 mm.; Florida, Texas . . . . . **22. piger** (Dyar)

Cucullus of harpe broadly and unevenly expanded ventrad beyond base to present asymmetrically capitate appearance (fig. 118), costa of harpe with only very slight dorsal expansion caudad of point of attachment of arm of transtilla (fig. 118); vesica of aedeagus armed about perimeter with approximately 15 variously sized, well sclerotized, distinct cornuti arranged in form of incomplete oval (figs. 119, 120); wing expanse usually greater than 16 mm.; Texas, Arizona . . . . . **23. vanduzeei,** new species

26. Cucullus of harpe with major portion directed considerably ventrad (figs. 122, 125) and with apical margin markedly dentate (fig. 122) or produced into at least one large, acute, spinelike process (fig. 125); (*kearfotti-pseudohirsutus* species group) 27

Cucullus of harpe with or without major portion directed considerably ventrad but with apical margin neither dentate nor produced into spinelike processes 28

27. Cucullus of harpe with central portion of ventral margin roughly dentate, with apical portion somewhat expanded; with apical margin dentate, produced into 5 to 10 teeth of various sizes, ventral tooth often the largest (fig. 122); wing expanse 17 to 21 mm. . . **24. pseudohirsutus,** new name

Cucullus of harpe with central portion of ventral margin not dentate, with apical portion somewhat narrowed; apex of cucullus emarginate, with dorsal extremity in form of subtriangular projection, with ventral extremity produced into large and elongate process directed strongly mesad (fig. 125); wing expanse 22 to 29 mm. . . . . **25. kearfotti** (Dyar)

28. Uncus bifid but with furcae closely appressed and often superficially appearing as single process with median longitudinal suture (fig. 131); (*furcatus-punctellus* species group—relationship not exceedingly close) 29

Uncus simple, with uncal process not appearing to have median longitudinal suture (figs. 138, 143) 30

29. Cucullus of harpe with apical portion considerably expanded and directed dorsad (fig. 127); aedeagus elongate and slender (fig. 128), with base moderately expanded laterad and ventrad (figs. 128, 129); vesica of aedeagus unarmed (figs. 128, 130) . . . . . **26. furcatus** (Walsingham)

Cucullus of harpe with apical portion expanded and directed ventrad (fig. 132); aedeagus of medium length and width (fig. 133), with base broadly expanded laterad into pair of subdigitate processes (figs. 133, 134); vesica of aedeagus armed with several cornuti (figs. 133, 134).

27. punctellus (Busck)

30. Cucullus of harpe directed considerably ventrad, with major apical portion broad, with dorsal and ventral margins approximately linear and parallel, with apex truncate or nearly so (fig. 139); gnathos as a rule armed laterad near apex with pair of small, acute, toothlike processes (figs. 142, 143); vesica of aedeagus with free portion broader than and almost as long as aedeagus (fig. 141) or slender but longer than aedeagus, often twisted or spiraled . . . . . **28. cockerelli** (Dyar)

Cucullus of harpe partly (fig. 135) or entirely unlike above; gnathos unarmed (fig. 138); vesica of aedeagus with only small free portion 31

31. Forewings almost as dark as hindwings, mottled with dark patches, never pale grayish white or whitish yellow; cucullus of harpe elongate and slender, with dorsal and ventral margins sublinear and subparallel, apex of cucullus with dorsal portion developed further distad than ventral portion (fig. 206); aedeagus very slender, sickle-shaped, curving through angle of approximately 90 degrees (fig. 207); vesica arising from approximate apical four-fifths of aedeagus (fig. 207). [See couplet 52 for species-group relationship] . . . . . **45. seculatus,** new species

Forewings dark to light in color; cucullus of harpe partly (fig. 148) or entirely unlike above; aedeagus not exceedingly slender, sublinear (fig. 146) or with curvature much less than 90 degrees (fig. 136); vesica arising only from apical portion of aedeagus (figs. 136, 146) 32

32. Cucullus of harpe curving somewhat ventrad; apex of cucullus expanded, emarginate, with dorsal portion developed further distad than ventral portion (fig. 135); vesica of aedeagus armed at apex with single, large cornutus (figs. 136, 137) . . **29. pyramellus** (Barnes and McDunnough)

Cucullus of harpe not as above (figs. 144, 145, 147, 148, 149); vesica of aedeagus unarmed (fig. 146); (*laticapitanus*) 33

33. Each antennal segment with 2 complete rings of scales; forewings pale whitish yellow; cucullus of harpe shaped as in figs. 144 or 145.

30a. laticapitanus laticapitanus (Walsingham), new combination

Each antennal segment with only 1 complete ring of scales; forewings pale yellow to dark; cucullus of harpe shaped as above or as in figures 147, 148, or 149 34

34. Forewings grayish white or dark; cucullus of harpe with dorsal portion of apex considerably reduced and ventral portion correspondingly produced distad (figs. 144, 145, 147) 35

Forewings pale yellow; cucullus of harpe with dorsal portion of apex developed further distad than ventral portion (figs. 148, 149) 36

35. Larger, wings mostly 20–24 mm. in expanse; but little contrast in ground color between dark forewings and hindwings; cucullus of harpe with ventral margin concave (figs. 144, 145).

30b. laticapitanus occidens Busck, new combination

Smaller, wings 17–20 mm. in expanse; grayish white ground color of forewings contrasting with dark hindwings; cucullus of harpe with ventral margin convex (fig. 147).

30c. laticapitanus occidens form **leopardus** Busck, new combination

36. Cucullus of harpe rather slender, sublinear, with dorsal and ventral margins subparallel, with apex subtruncate (fig. 148).

30d. laticapitanus heinrichi, new subspecies

Cucullus of harpe broadly and unevenly expanded, with apex broadly and unevenly rounded (fig. 149) . **30e. laticapitanus clarkei,** new subspecies

37. Uncus obviously bifid, with furcae well separated (figs. 87, 94, 155, 161). 38

Uncus simple (fig. 208), uncal process bifid only at apical extremity (fig. 189), or uncus obscurely bifid and with furcae very closely appressed (figs. 167, 180) 41

38. Antennae strongly bipectinate or strongly unipectinate; (*macrogaster-balduf* species group, in part). [See couplet 16 for relationship] 39

Antennae simple, laminate, with segments laterally flattened 40

39. Antennae strongly bipectinate.

15b. macrogaster bipectinicornus, new subspecies

Antennae strongly unipectinate . . . . . **16. balduf,** new species

40. Eyes heavily setose, each with prominent anterior tuft of lashes. **31. arcanellus** (Clemens)
Eyes naked, without prominent tufts of lashes . . . . . **32. morus** (Grote)
41. Eastern species: Atlantic States; small, wing expanse rarely greater than 18 mm. 42
Western species: Texas and westward; medium to large, wing expanse rarely less than 18 mm. 43
42. Eyes sparsely setose; cucullus of harpe with apical portion broadly and evenly expanded, capitate (fig. 162); uncus simple; vesica of aedeagus armed with 15 to 20 small cornuti (fig. 163) . . **33. forbesi,** new species
Eyes naked; cucullus of harpe with apical portion only very slightly expanded, not capitate (fig. 164); uncus with apical portion very obscurely bifid (fig. 167); vesica of aedeagus unarmed (fig. 165) . . **34. panamae** Busck
43. Antennae strongly bipectinate, processes of each segment with separate origins 44
Antennae simple to complex, but never as above 45
44. Labial palpi rather short, barely extending onto anterior margin of thorax; uncal process short and relatively robust, curving strongly ventrad; cucullus comprising less than apical half of harpe, with pronounced ventral constriction at base (fig. 168); aedeagus markedly asymmetrical, distinctive (figs. 169, 170); anellus armed with large, pouchlike juxta (fig. 171). **35. juxtatus,** new species
Labial palpi of intermediate length, noticeably extending onto anterior margin of thorax; uncal process elongate and relatively slender, curving only slightly ventrad; cucullus comprising at least apical half of harpe, without ventral constriction at base (fig. 172); aedeagus asymmetrical, but entirely unlike that of above (figs. 173, 174); anellus unarmed, or with only faint trace of juxta . . . . . **36. chiricahuae,** new species
45. Cucullus of harpe very broadly expanded in lateral aspect (figs. 175, 177, 182, 184); (*persimplex-fervidus-sinclairi* species group) 46
Cucullus of harpe not broadly expanded in lateral aspect (figs. 186, 193, 196, 199) 49
46. Forewings with major portions pale, with ground color whitish ochreous overlaid with stripes and shadings of bright reddish brown scales; cucullus of harpe markedly narrowed dorsad near base, with apex correspondingly expanded dorsad (fig. 175); aedeagus with apex produced into prominent, recurved process (fig. 176) . . . . . **37. fervidus** Busck
Forewings not brightly and contrastingly colored as above, with ground color considerably darker; cucullus of harpe not appreciably narrowed dorsad near base, with apex only slightly expanded dorsad (figs. 177, 182, 184); aedeagus with apex not produced as above (figs. 179, 183) . . . 47
47. Antennae transitional between laminate and unipectinate, with segmental processes subglobose and considerably reduced, each process armed at apex with minute spine directed toward apex of antenna; forewing heavily suffused with fuscous merging into prominent fuscous patch in center of posterior margin; cucullus of harpe with central portion not appreciably narrowed ventrad (fig. 177), ental surface of cucullus armed with prominent clasper (fig. 178) . . . . . **38. persimplex** (Dyar)
Antennae unipectinate or reduced bipectinate, with segmental processes not as above; forewing not heavily suffused with fuscous, without fuscous patch in center of posterior margin; cucullus of harpe with central portion considerably narrowed ventrad (figs. 182, 184), ental surface of cucullus without clasper (*sinclairi*, new species) 48

48. Antennae unipectinate; with each segmental process (fig. 181) subcircular, developed ventrad rather than laterad, somewhat thickened in lateral aspect . . . . . **39a. sinclairi sinclairi,** new subspecies

Antennae reduced bipectinate; with each segmental process (fig. 185) somewhat emarginate mesad, developed strongly laterad into pair of secondary processes narrowly rounded at apices, quite slender in lateral aspect.

39b. sinclairi nelsoni, new subspecies

49. Cucullus of harpe with ventral margin prominently dentate (fig. 186), densely clothed with stout setae; gnathos distinctively paired, with angle of bifurcation between arms broadly and evenly rounded (figs. 188, 189); arms of gnathos elongate, divergent, with apical halves narrowing and becoming very heavily sclerotized distad (fig. 188).

40. quadrellus (Barnes and McDunnough)

Cucullus of harpe with ventral margin smooth, not setose as above; gnathos single or paired, but never as above 50

50. Antennae reduced bipectinate; with each segmental process (fig. 190) somewhat emarginate mesad, developed strongly laterad into pair of secondary processes rounded at apices; aedeagus with apical margin produced into 10 or 12 small, unequally sized, finely acute, spinelike processes (fig. 195).

41. minor (Dyar)

Antennae laminate or reduced unipectinate, but with segmental processes never developed laterad; aedeagus with apical margin not produced as above 51

51. Cucullus of harpe with major central portion markedly flattened dorsoventrad and appearing quite slender in lateral aspect (fig. 196), costa of harpe produced dorsocaudad into distinct costal process (fig. 196); uncus obscurely bifid, with furcae very closely appressed and superficially appearing as single process with median longitudinal suture.

42. parvipalpus, new species

Cucullus of harpe not flattened dorsoventrad, costa of harpe without process; uncus single 52

52. Robust species; labial palpi recurved, rather closely appressed to head, with normal vestiture; sacculus of harpe developed mesoventrad into prominent process usually visible in dried specimens in ventral aspect (figs. 200, 203); gnathos rather weakly paired, flattened beneath; (*davisellus-serratus* species group) 53

Rather fragile species; labial palpi erect, not appressed to head, each segment clothed with prominent tuft of scales along anterior margin; sacculus of harpe without mesoventral process; gnathos fused (fig. 210), concave beneath, hood-shaped (fig. 219); (*variabilis-seculatus-macrophallus-vauriei* species group, in part). [See couplet 31 for *seculatus*] 54

53. Labial palpi short, extending only about as far as antennal bases; antennae laminate, with segmental processes laterally flattened and contiguous; forewings heavily suffused with grayish white; cucullus of harpe with apical portion expanded, moderately capitate (fig. 199); sacculus of harpe broadly separated caudad from its mesoventral process (figs. 199, 200); apical portion of aedeagus heavily armed ventrad with spinelike processes (fig. 201) . . . . . **43. davisellus** Beutenmüller

Labial palpi of intermediate length, extending onto anterior margin of thorax; antennae transitional between laminate and unipectinate, with segmental processes somewhat thickened transversely and not contiguous; forewings brownish, not suffused with grayish white; cucullus of harpe very slender, with apical portion not appreciably expanded (fig. 202); sacculus of harpe

almost completely fused with its mesoventral process (fig. 203); apical portion of aedeagus weakly dentate or serrate dextrad (figs. 204, 205), not spinose . . . . . **44. serratus,** new species

54. Cucullus of harpe with dorsal margin prominently emarginate and dentate near base (fig. 211); aedeagus with apical quarter to third heavily armed with series of variously sized spines (figs. 212, 213).
46. variabilis (Walsingham)

Cucullus of harpe with dorsal margin smooth (fig. 214) or very faintly serrate near base (fig. 217); aedeagus armed only at extreme apex with one or two spines (figs. 215, 216, 218) 55

55. Eyes sparsely setose; forewings brownish, not suffused with grayish white; aedeagus greatly elongated (fig. 216), with apical portion extruded in dried specimens; vesica of aedeagus armed at or near apex with large cornutus (fig. 215); Arizona . . . . . **47. macrophallus,** new species

Eyes naked or nearly so; forewings heavily suffused with grayish white; aedeagus not greatly elongated (fig. 218), usually not extruded in dried specimens; vesica of aedeagus armed at apex with 2 or 3 small cornuti (fig. 218); western Texas . . . . . **48. vauriei,** new species

Checklist

The following annotated list represents my final disposition of the names referable to the members of the genus *Acrolophus* occurring in America north of Mexico. The sequence of species and lesser categories is essentially the same as that found in the key, since the latter furnishes the best available illustration of the natural relationships within this group.

1. dorsimaculus (Dyar).
2. griseus (Walsingham).
   a. *griseus griseus* (Walsingham), new combination.
      griseus leucallactis Meyrick, new synonym.
   b. *griseus capitatus*, new subspecies.
3. texanellus (Chambers).
      hulstellus Beutenmüller, new synonym.
      barnesi (Dyar), new synonym.
4. acornus, new species.
5. simulatus Walsingham.
6. exaphristus Meyrick, incertae sedis, no specimen available.
7. bicornutus, new species.
8. filicicornis (Walsingham).
      mexicanellus (♀) Beutenmüller (Mexican).
9. plumifrontellus (Clemens).
      bombycinus (Zeller).
      cervinus (♀) Walsingham.
      angustipennellus Beutenmüller.
10. mortipennellus (Grote).
      quadripunctellus (Dyar).
      carphologus Meyrick, new synonym.
      zeellus, validation of manuscript name through placement as a new synonym.

11. popeanellus (Clemens).
    agrotipennellus (Grote).
    scardinus (Zeller), no specimen available, type ♂ not North American.
    morrisoni (Walsingham), new synonym.
    confusellus (Dyar), new synonym.
12. acanthogonus Meyrick, incertae sedis, no specimen available.
13. klotsi, new species.
14. propinquus (Walsingham).
    tenuis (Walsingham), new synonym.
    violaceellus Beutenmüller.
    buscklellus (♀) (Haimbach), new synonym.
15. macrogaster (Walsingham).
    a. *macrogaster macrogaster* (Walsingham), new combination, no specimen available.
    b. *macrogaster bipectinicornus*, new subspecies.
    c. *macrogaster unipectinicornus*, new subspecies.
    d. *macrogaster laminicornus*, new subspecies.
16. baldufi, new species.
17. arizonellus Walsingham.
18. luriei, new species.
19. maculifer (Walsingham).
20. cressoni (Walsingham).
21. crescentellus (Kearfott).
22. piger (Dyar).
23. vanduzeei, new species.
24. pseudohirsutus, new name.
    hirsutus Busck, new synonym.
25. kearfotti (Dyar).
    diversus Busck, new synonym.
26. furcatus (Walsingham).
27. punctellus (Busck).
28. cockerelli (Dyar).
29. pyramellus (Barnes & McDunnough).
30. laticapitanus (Walsingham).
    a. *laticapitanus laticapitanus* (Walsingham), new combination.
       laticapitanus unistriganus (Dyar), new synonym.
    b. *laticapitanus occidens* Busck, new combination.
       laticapitanus flavicomus Busck, new synonym.
    c. *laticapitanus occidens*, form *leopardus* Busck, new combination.
    d. *laticapitanus heinrichi*, new subspecies.
    e. *laticapitanus clarkei*, new subspecies.
31. arcanellus (Clemens).
32. morus (♀) (Grote).
33. forbesi, new species.
34. panamae Busck.
35. juxtatus, new species.
36. chiricahuae, new species.
37. fervidus Busck.
    antonellus (Barnes & McDunnough), new synonym.
38. persimplex (Dyar).

39. sinclairi, new species.
    a. *sinclairi sinclairi*, new subspecies.
    b. *sinclairi nelsoni*, new subspecies.
40. quadrellus (Barnes & McDunnough).
41. minor (Dyar), new status.
    coloradellus (Walsingham), new synonym.
42. parvipalpus, new species.
43. davisellus Beutenmüller.
44. serratus, new species.
45. seculatus, new species.
46. variabilis (Walsingham).
47. macrophallus, new species.
48. vauriei, new species.

Illustrations

The male genitalia of 52 species and subspecies of *Acrolophus* are figured, entirely or in part, on pages 682–699. The 2 species and 3 subspecies whose genitalia are not illustrated are: *A. exaphristus* Meyrick, *A. acanthogonus* Meyrick, and *A. macrogaster macrogaster* (Walsingham), for which no specimens were available; *A. macrogaster bipectinicornus*, new subspecies, the genitalia of which are essentially the same as those figured for *A. macrogaster laminicornus*, new subspecies; and *A. laticapitanus laticapitanus* (Walsingham), with genitalia essentially the same as those figured for *A. laticapitanus occidens* Busck.

Family Acrolophidae Busck, 1912

ANAPHORINAE Walsingham, 1887, Trans. Ent. Soc. London, pp. 138, 140.—Fernald, 1888, Ent. Amer., vol. 3, no. 10, pp. 195–196.—Riley, 1888, Insect Life, vol. 1, no. 6, p. 195.—Walsingham, 1891, Proc. Zool. Soc. London, pp. 511–516, 544–545; 1897, Proc. Zool. Soc. London, p. 169.—Dyar, 1900, Can. Ent., vol. 32, no. 10, p. 306; vol. 32, no. 11, p. 326.—Barnes & McDunnough, 1913, Can. Ent., vol. 45, no. 12, p. 419.

ANAPHORIDAE Smith, 1891, List Lep. Bor. Amer., pp. 94–95, nos. 5043–5066.

ACROLOPHIDAE Busck, 1912, Report Laguna Marine Lab., vol. 1, p. 169, May (Acrolophidae); 1912, Proc. Ent. Soc. Washington, vol. 14, no. 3, p. 184, Sept.; 1914, Proc. Ent. Soc. Washington, vol. 16, no. 2, pp. 51, 53, 54, pl. 2.—Walsingham, 1915, Biol. Centr.-Amer., pt. 12, vol. 4, p. 375.— Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, nos. 8154–8195.—Comstock, 1924, Introd. to Ent., pp. 582, 589, 611.—Eyer, 1924, Ann. Ent. Soc. Amer., vol. 17, no. 3, pp. 302, 311–312, 314–317, 320–321, text fig. x; 1926, Ann. Ent. Soc. Amer., vol. 19, no. 2, pp. 241–242.—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., pp. 103–104, nos. 9540–9585.—da Costa Lima, 1945, Insetos do Brasil, pp. 210–212, figs. 95–97.

ACROLOPHINAE Forbes, 1923, Lep. New York, pp. 50, 53, 116, 119, 122.

TYPE GENUS.—*Acrolophus* Poey, 1832.

Acrolophus Poey, 1832

Acrolophus Poey, 1832, Cent. Lép. Cuba, pp. 51–53, no. 20, pl. 20, July.—Walsingham, 1887, Trans. Ent. Soc. London, p. 147.—Smith, 1891, List Lep. Bor. Amer., p. 94, nos. 5047–5058.—Dyar, 1900, Can. Ent., vol. 32, no. 10, pp. 306, 308–309; 1903, List North Amer. Lep., p. 578, nos. 6584–6589.—Meyrick, 1913, Trans. Ent. Soc. London, p. 191.—Walsingham, 1915, Biol. Centr.-Amer., pt. 12, vol. 4, p. 375.—Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, nos. 8154–8195.—Forbes, 1923, Lep. New York, pp. 15, 115–116, 119–120.—Comstock, 1924, Introd. to Ent., p. 611.—Eyer, 1924, Ann. Ent. Soc. Amer., vol. 17, no. 3, p. 315.—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., pp. 103–104, nos. 9540–9585. (Type of genus *Acrolophus vitellus* Poey; Cuban, not North American.)

Anaphora Clemens, 1859, Proc. Acad. Nat. Sci. Philadelphia, p. 260, Sept.; 1872, Tineina of North Amer. (ed., Stainton), pp. vii, 56–60.—Zeller, 1873, Verh. zool.-bot. Ges. Wien, vol. 23, pp. 214–215.—Chambers, 1878, Bull. U.S. Geol. & Geogr. Surv. Terr., vol. 4, no. 1, p. 128.—Walsingham, 1887, Trans. Ent. Soc. London, p. 155.—Smith, 1891, List Lep. Bor. Amer., p. 95, nos. 5059–5063.—Walsingham, 1891, Proc. Zool. Soc. London, p. 517.—Dyar, 1900, Can. Ent., vol. 32, no. 10, pp. 306, 309; 1900, Can. Ent.,vol. 32, no. 11, pp. 326–327; 1903, List North Amer. Lep., pp. 578–579, nos. 6591–6596.—Meyrick, 1913, Trans. Ent. Soc. London, p. 191.—Walsingham, 1915, Biol. Centr.-Amer., pt. 12, vol. 4, p. 376.—Eyer, 1924, Ann. Ent. Soc. Amer., vol. 17, no. 3, p. 315. (Type of genus *Anaphora popeanella* Clemens; designated by Walsingham, Trans. Ent. Soc. London, 1887, pp. 155–156.)

Eutheca Grote, 1881, Bull. U.S. Geol. & Geogr. Surv. Terr., vol. 6, no. 2, p. 257, Sept. (a preoccupied name, being homonymous with *Eutheca* Kiesenwetter, 1877, Coleoptera).—Dyar, 1900, Can. Ent., vol. 32, no. 10, p. 310 (here confused as a synonym of *Pseudanaphora* Walsingham).—Meyrick, 1913, Trans. Ent. Soc. London, p. 191. (Type of genus *Eutheca* (*Sapinella*) *mora* Grote.)

Sapinella Kirby, 1892, Syn. Cat. Lep. Het., vol. 1, p. 524, genus 45 (Kirby proposed new name *Sapinella* to replace *Eutheca* Grote).

Eutheca (*Sapinella*) Dyar, 1895, Can. Ent., vol. 27, no. 1, p. 15.

Sapinella (*Eutheca*) Walsingham, 1915, Biol. Centr.-Amer., pt. 12, vol. 4, p. 378.

Eulepiste Walsingham, 1882, Trans. Amer. Ent. Soc., vol. 10, p. 169, Nov.—Walsingham, 1887, Trans. Ent. Soc. London, p. 142.—Smith, 1891, List Lep. Bor. Amer., p. 94, nos. 5044–5045.—Walsingham, 1891, Proc. Zool. Soc. London, p. 511.—Dyar, 1900, Can. Ent., vol. 32, no. 10, pp. 306–307; 1903, List North Amer. Lep., p. 577, nos. 6579–6581.—Busck, 1910, Proc. Ent. Soc. Washington, vol. 11, no. 4, p. 186.—Busck, 1912, Rep. Laguna Marine Lab., vol. 1, p. 169.—Meyrick, 1913, Trans. Ent. Soc. London, p. 191.—Walsingham, 1915, Biol. Centr.-Amer., pt. 12, vol. 4, p. 377. (Type of genus *Eulepiste cressoni* Walsingham.)

Pseudoconchylis Walsingham, 1884, Trans. Ent. Soc. London, p. 133, April.—Smith, 1891, List Lep. Bor. Amer., p. 90, no. 4770.—Dyar, 1903, List North Amer. Lep., p. 488, no. 5469.—Busck, 1907, Journ. New York Ent. Soc., vol. 15, no. 1, p. 20.—Walsingham, 1915, Biol. Centr.-Amer., pt. 12, vol. 4, p.377. (Type of genus *Pseudoconchylis laticapitana* Walsingham.)

Neolophus Walsingham, 1887, Trans. Ent. Soc. London, p. 141, June.—Smith, 1891, List Lep. Bor. Amer., p. 94, no. 5043.—Dyar, 1900, Can. Ent., vol. 32, no. 10, p. 306; 1903, List North Amer. Lep., p. 577, nos. 6577–6578.—Busck,

1910, Proc. Ent. Soc. Washington, vol. 11, no. 4, p. 186; 1912, Proc. Ent. Soc. Washington, vol. 14, no. 3, p. 184.—Meyrick, 1913, Trans. Ent. Soc. London, p. 191.—Walsingham, 1915, Biol. Centr.-Amer., pt. 12, vol. 4, p. 377. (Type of genus *Neolophus furcatus* Walsingham.)

Hypoclopus Walsingham, 1887, Trans. Ent. Soc. London, p. 144, June.—Smith, 1891, List Lep. Bor. Amer., p. 94, no. 5046.—Dyar, 1900, Can. Ent., vol. 32, no. 10, pp. 306–308; 1903, List North Amer. Lep., pp. 577–578, nos. 6582–6583, (here misspelled as "*Hypocolpus*").—Meyrick, 1913, Trans. Ent. Soc. London, p. 191.—Walsingham, 1915, Biol. Centr.-Amer., pt. 12, vol. 4, p. 377.—Eyer, 1924, Ann. Ent. Soc. Amer., vol. 17, no. 3, p. 315. (Type of genus *Hypoclopus griseus* Walsingham.)

Ankistrophorus Walsingham, 1887, Trans. Ent. Soc. London, p. 146, June (a preoccupied name, being homonymous with *Ancistrophora* Schiner, 1865, Diptera).—Dyar, 1900, Can. Ent., vol. 32, no. 10, p. 306.—Meyrick, 1913, Trans. Ent. Soc. London, p. 191.

Homonymus Walsingham, 1887, Proc. Ent. Soc. London, p. liv, Nov. (new name proposed by Walsingham to replace his *Ankistrophorus*); 1907, Proc. U.S. Nat. Mus., vol. 33, p. 228.—(*Ankistrophorus*) Walsingham, 1915, Biol. Centr.-Amer., pt. 12, vol. 4, p. 378. (Type of genus *Ankistrophorus* (*Homonymus*) *corrientis* Walsingham. Argentine, not North American.)

Felderia Walsingham, 1887, Trans. Ent. Soc. London, p. 165, June.—Smith, 1891, List Lep. Bor. Amer., p. 95, nos. 5064 & 5064a.—Dyar, 1900, Can. Ent., vol. 32, no. 10, pp. 306, 309–310; 1903, List North Amer. Lep., p. 579, nos. 6599–6600.—Meyrick, 1913, Trans. Ent. Soc. London, p. 191.—Walsingham, 1915, Biol. Centr.-Amer., pt. 12, vol. 4, p. 377. (Type of genus *Acrolophus cossoides* Felder & Rogenhofer. "Ypanema," not North American.)

Ortholophus Walsingham, 1887, Trans. Ent. Soc. London, p. 169, June.—Smith, 1891, List Lep. Bor. Amer., p. 95, no. 5065.—Dyar, 1900, Can. Ent., vol. 32, no. 10, pp. 306, 310; 1900, Can. Ent., vol. 32, no. 11, p. 327; 1903, List North Amer. Lep., p. 579, nos. 6597–6598.—Meyrick, 1913, Trans. Ent. Soc. London, p. 191.—Walsingham, 1915, Biol. Centr.-Amer., pt. 12, vol. 4, p. 378. (Type of genus *Ortholophus variabilis* Walsingham.)

Pseudanaphora Walsingham, 1887, Trans. Ent. Soc. London, p. 170, June.—Smith, 1891, List Lep. Bor. Amer., p. 95, no. 5066.—Walsingham, 1891, Proc. Zool. Soc. London, p. 517.—Dyar, 1900, Can. Ent., vol. 32, no. 10, pp. 306, 310 (here confused with *Eutheca* Grote); 1903, List North Amer. Lep., p. 579, nos. 6601–6603.—Meyrick, 1913, Trans. Ent. Soc. London, p. 191.—Walsingham, 1915, Biol. Centr.-Amer., pt. 12, vol. 4, p. 378. (Type of genus *Anaphora arcanella* Clemens.)

Atopocera Walsingham, 1897, Proc. Zool. Soc. London, p. 169, Jan.—Dyar, 1900, Can. Ent., vol. 32, no. 10, p. 306; 1900, Can. Ent., vol. 32, no. 11, p. 326; 1903, List North Amer. Lep., p. 578, no. 6590.—Meyrick, 1913, Trans. Ent. Soc. London, p. 191.—Walsingham, 1915, Biol. Centr.-Amer., pt. 12, vol. 4, p. 378. (Type of genus *Atopocera occultum* Walsingham. Haitian, not North American.)

Walsingham (1887a, pp. 154–155) described the genus *Caenogenes*, based on a species from Argentina, stating: "A specimen sent to me for examination some years ago by Prof. Fernald under the name *Anaphora mortipennella*, Grote, greatly resembled it in structure." In the British Museum (Natural History) there is a manuscript type ♂ specimen labeled "*Caenogenes zeella* Fernald (MS.) Illinois." Photo-

graphs of this moth and its genitalia clearly represent a typical specimen of *Acrolophus mortipennellus* (Grote). Thus, Fernald's manuscript species name (chironym) and the specimen it designates (chirotype) are synonymous with Grote's species. Forbes (1890, p. 101, pl. 6, fig. 1) refers to *"Caenogenes mortipennella"* in Illinois. However, no North American species of Acrolophidae has ever been described as new under *Caenogenes*.

1. *Acrolophus dorsimaculus* (Dyar)

FIGURES 25–29

Felderia dorsimacula Dyar, 1900, Can. Ent., vol. 32, no. 11, p. 328, Nov.; 1903, List North Amer. Lep., p. 579, no. 6600.

Acrolophus dorsimacula Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8191.— McDunnough, 1939, Check List Lep. Can. & U. S. Amer., p. 104, no. 9581.

Dyar's original description of this species follows:

Felderia dorsimacula—Palpi strongly recurved to base of thorax, pale gray before, black outwardly; head and thorax dark gray. Fore wing gray, dark on the costal half, more cinereous along internal margin, mottled with dark brown. A triangular black patch with point on centre of inner margin and the broadest side on the median vein, joined outwardly to a triangular discal patch, that is extended in a curved band nearly to apex, where it becomes obsolete. Hind wings rather light gray, a little darker toward the margin. Expanse 24 to 26 mm. Male genitalia with uncus single, a broad triangular plate, tapering rapidly to a point; harpes slender, rather flat, long, well curved at base, the tips oblique above.

Nine specimens: Huachuca Mts., Arizona; July 24 to Aug. 15 (Dr. W. Barnes); U.S. Nat. Mus., type No. 5346.

MALE GENITALIA.—Vinculum rather large, well sclerotized, otherwise typical.

Tegumen very narrow, glabrous; lateral arm elongate, sublinear, margins subparallel; dorsal area separated from base of uncus by areas of reduced sclerotization.

Harpe simple, with major portion of cucullus curving strongly toward meson of genital capsule in dorsal and ventral aspects. Costa and sacculus in lateral aspect fused, rather elongate and narrow, comprising approximate basal three-fifths of harpe, glabrous, broadest in central portion, apical portion only slightly narrowed, basal third considerably narrowed. Cucullus in lateral aspect quite distinctly set off from costa and sacculus by areas of reduced sclerotization, ectal surface heavily punctate except for glabrous basal extremity, ental surface and margins rather sparsely setose, approximate basal third slightly constricted and curving somewhat dorsad, apical two-thirds expanded and directed somewhat ventrad; in dorsal aspect approximate basal third irregularly expanded toward meson, basal

portion with heavily sclerotized margins and rather weakly sclerotized mesal area, approximate apical two-thirds to three-fourths gradually expanding distad and curving strongly toward meson, broadest near apex, apex markedly emarginate.

Transtilla with arm glabrous, well sclerotized, approximately one-fourth as long as harpe, sinuate, apical portion converging to margin of costa, terminating subacutely somewhat caudad of basal extremity of harpe.

Uncus obscurely and weakly bifid. Dorsal aspect: subtriangular, distinctly set off from tegumen by irregular areas of reduced sclerotization, cephalic margin broadly and evenly emarginate mesad, laterobasal areas finely but heavily punctate, apical portion finely and sparsely punctate, lateral margins sublinear and evenly converging caudad into furcae; angle of bifurcation obscured; furcae very short, stout, approximate, well sclerotized, sparsely punctate, evenly curving caudoventrad, apices subacute to acute.

Gnathos weakly paired, somewhat reduced, rather short, directed mostly ventrad, mesal portion weakly sclerotized, lateral margins heavily sclerotized and evenly converging distad; apical extremities short, rather stout, weakly scobinate, curving ventrocaudad, apices subacute to narrowly rounded.

Anellus very large; dorsal surface composed mostly of large, somewhat irregular, rather weakly but distinctly sclerotized area articulating with surrounding portions by means of definite membranous infoldings; remainder membranous, unarmed, juxta absent.

Aedeagus very large and distinctive, approximately two-thirds as long as harpe, considerably flattened dorsoventrad and normally resting just beneath sclerotized dorsal area of anellus, greatly expanded laterad and appearing goblet-shaped in dorsal and ventral aspects, asymmetrical, directed slightly ventrad in lateral aspect, base considerably expanded laterad and opening broadly dorsad, portion just above base constricted to about half width of base, approximate apical five-sevenths very broadly expanded laterad and opening broadly but rather indistinctly in dorsomesal and apical areas, apex very broad and irregularly emarginate; dextral margin of apical portion armed with several dozen, variously sized, heavily sclerotized, acute, spinelike processes directed laterad and distad; approximately five to six circular, well sclerotized inclusions scattered near bases of spinelike processes.

Vesica fairly large, membranous, apparently unarmed, limits vague and blending with weakly sclerotized areas of aedeagus, appearing as free and distinct membrane only at sinistral apical extremity of aedeagus.

TYPE.—Type ♂ (type no. 5346) in the U.S. National Museum.

TYPE LOCALITY.—Huachuca Mountains, Ariz.

DISTRIBUTION.—Southwestern United States. Southern Arizona.

SOURCES OF MATERIAL: California Academy of Sciences (6 ♂♂, 1 ♀), Carnegie Museum (1 ♂).

SPECIMENS EXAMINED.—8 (7 ♂♂, 1 ♀), from 2 localities:

ARIZONA: Palmerlee, Cochise Co., ♂ (date and collector unknown); Patagonia, Santa Cruz Co., 3 ♂♂, ♀ (Aug. 1, 1924, E. P. Van Duzee), 3 ♂♂ (Aug. 2, 1924, Van Duzee).

REMARKS.—This species undoubtedly ranges southward into Mexico. The specific name should be spelled *dorsimaculus* to agree grammatically with its present genus. In general, it is related to those acrolophids having elongate labial palpi, but it is not closely related to any one species. The structures on the head of *dorsimaculus* furnish a distinctive combination of elongate labial palpi, naked eyes, and bipectinate antennae. In addition, the genitalia of this species may be distinguished from those of all other acrolophids by the inward curvature of the cucullus of the harpe and by the greatly expanded, calyciform aedeagus.

I have examined the type ♂ specimen at the U.S. National Museum. It is labeled "*Felderia dorsimacula* Dyar, type no. 5346, Huachuca Mts., Ariz., July 24–30." Dr. Clarke kindly removed the genitalia of the type for me and the identity of this species was thus further confirmed. Dyar, in his list of 1903, also reported this species from Texas. However, I have seen no examples of *dorsimaculus* from that State.

2. *Acrolophus griseus* (Walsingham)

This complex species is composed of the two subspecies treated below.

2a. *Acrolophus griseus griseus* (Walsingham), new combination

FIGURES 30–34

Hypoclopus griseus Walsingham, 1887, Trans. Ent. Soc. London, p. 144, pl. 7, figs. 2, 2a, 2b, June.—Smith, 1891, List Lep. Bor. Amer., p. 94, no. 5046.—Dyar, 1900, Can. Ent., vol. 32, no. 10, p. 307; 1903, List North Amer. Lep., p. 577, no. 6582.—Walsingham, 1915, Biol. Centr.-Amer., pt. 12, vol. 4, p. 377.

Acrolophus griseus Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8168.—Forbes, 1923, Lep. New York, pp. 120, 122.—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 103, no. 9554.

Acrolophus leucallactis Meyrick, 1919, Exotic Microlep., vol. 2, no. 9, p. 281, Nov.—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 103, no. 9574. (New synonymy.)

Walsingham's original description follows:

Hypoclopus griseus—*Palpi*, ♂, overarching the thorax and reaching to its posterior margin; ♀ short, standing straight forward from the head about 1 mm.

Antennae dull greyish ochreous; ♂ compressed, ovate, pilose, having a serrate appearance owing to lines of partially raised scales on their anterior sides; ♀ simple. *Head, thorax, and palpi* with an equal admixture of hoary and greyish fuscous scales. *Fore wings* greyish fuscous, profusely sprinkled with hoary scales, which predominate in a patch below the middle of the fold; a sprinkling of dark fuscous scales is also noticeable, especially along the costa, where they form a series of small dots, and at the outer end of the cell, where they are concentrated into an ill-defined dark fuscous patch; a smaller dark fuscous patch occurring beyond the middle of the fold. In the fringes patches of hoary and greyish fuscous scales alternate with each other. The apical vein is forked. *Hind wings* reddish brown; fringes cinereous. *Abdomen* cinereous; lateral claspers attenuated in the middle and widened posteriorly, their ends rounded above, obtusely angulated below. The uncus is bent over and is single, but a supplementary point with a double stem in the form of the lower mandible of a bird, coming from below it, reaches nearly as far as the uncus itself. *Exp. al.* 26 mm.

Three males and one female received from Morrison, collected in Arizona. This species may be distinguished by its almost square-ended lateral claspers, and by the length of the opposite branch of the uncus, which, although it occurs in other species, does not appear to attain the same proportions; the forking of the apical vein and the single uncus separate it from other species having much the same general appearance.

Walsingham's illustrations consisted of figure 2, ♂ genitalia—uncus and cucullus in lateral aspect and uncus, gnathos, and cucullus in dorsal aspect; figure 2a, head of ♀ in lateral aspect; and figure 2b, neuration of forewing.

MALE GENITALIA.—Vinculum rather large but typical, as in other species.

Tegumen narrow, glabrous; lateral arm gradually and evenly narrowing to point of articulation with vinculum, margins sublinear, caudal margin very heavily sclerotized; dorsal area considerably constricted caudad, mesal portion fusing caudad with base of uncus.

Harpe simple. Ventral aspect: approximate basal two-thirds diverging caudad from meson of genital capsule, approximate apical third converging caudad toward meson. Lateral aspect: rather elongate and broad. Costa and sacculus fused, comprising approximate basal two-thirds of harpe, glabrous except for punctate and setose subdigitate ventrocaudal margin of sacculus, broadest in area caudad of point of attachment of arm of transtilla, basal portion evenly narrowing to rather narrow basal extremity. Cucullus set off from costa and sacculus by areas of reduced sclerotization, comprising approximate apical third of harpe, ventral portion of ental surface heavily punctate and setose, remainder and especially dorsal margin very sparsely punctate and setose, base constricted and with very heavily sclerotized dorsal margin, central and apical portions very broadly and evenly expanded dorsad and less broadly expanded ventrad to give marked capitate appearance, apical portion about twice

as broad as basal portion, apex broadly and evenly rounded dorsad and rather irregularly rounded ventrad.

Transtilla with arm glabrous, well sclerotized, slender, short, one-fourth to one-fifth as long as harpe, basal half diverging from and apical half converging toward margin of costa, terminating subacutely considerably caudad of basal extremity of harpe.

Uncus obscurely bifid, similar to that of *furcatus*. Dorsal aspect: base glabrous, lateral margins set off from tegumen by irregular areas of reduced sclerotization, mesocephalic portion indistinctly fused with tegumen, lateral margins very heavily sclerotized and evenly converging caudad into furcae; angle of bifurcation entirely obscured; furcae approximate, superficially appearing as single process with median longitudinal suture especially in dried or untreated specimens, elongate, narrow, heavily sclerotized, directed caudad and slightly ventrad, lateral margins sparsely punctate and setose, apices acute.

Gnathos fused, rather elongate and slender, directed caudad and slightly ventrad, mesal portion weakly sclerotized, apical portion heavily scobinate dorsad and with weakly sclerotized ventral expansion densely clothed with minute seta-like processes; lateral margins heavily sclerotized, gradually and evenly converging distad to rather narrowly rounded apex.

Anellus large, membranous, unarmed, juxta absent.

Aedeagus rather elongate and slender, approximately as long as harpe, cylindrical, asymmetrical, glabrous, sublinear in dorsal and ventral aspects except for apical portion irregularly curving somewhat sinistrad; base slightly expanded, emarginate ventrad, opening broadly dorsad; approximate apical half opening broadly lateroventrad and consisting of irregular, sclerotized, dorsal strip curving ventrad and back upon itself through angle of approximately 135° in lateral aspect; apex consisting of large, heavily sclerotized, acute, spinelike process extending free beyond vesica.

Vesica rather large, membranous, unarmed.

TYPE.—♂ and ♀ types in the British Museum (Natural History).

TYPE LOCALITY.—"Arizona."

DISTRIBUTION.—Southwestern United States. Arizona.

SOURCES OF MATERIAL: American Museum of Natural History (1 ♂, 1 ♀); Denison University (1 ♂).

SPECIMENS EXAMINED.—3 (2 ♂♂, 1 ♀), from 2 localities, as follows:

ARIZONA: Hualapai Mountains, ♂ (July 15-30, 1921, O. C. Duffner); locality and date unknown, ♂ ("Arizona"), ♀ ("Ariz., Chas. Palm, Don. 1911").

REMARKS.—This subspecies undoubtedly ranges southward into Mexico. Its synonym, *leucallactis* Meyrick, was described from Nogales, Santa Cruz County, Ariz., just north of the Mexican border.

The ♀ listed has not been positively associated with the ♂♂ of *griseus griseus*.

In general, the complex species, *griseus*, is related to those acrolophids having elongate labial palpi, but it is not closely related to any one species. The structures on its head furnish the distinctive combination of elongate labial palpi, naked eyes, and laminate antennae. In addition, the harpe and aedeagus of *griseus* are distinct from those of all other acrolophids.

The subspecies, *griseus griseus*, differs from its close relative, *griseus capitatus*, in having a considerably darker ground color in the forewings, a differently shaped cucullus of the harpe, and a different geographical distribution.

Mr. Tams of the British Museum (Natural History) has sent me photographs labeled "*griseus* Wals., type," showing the adult ♂ and ♀ and their respective genitalia. These photographs easily confirm the identity of this subspecies.

Dyar (1900) listed the following distributional data for *griseus*: "Oracle, Arizona, June 28 (E. A. Schwarz); San Diego, Texas, May 9 (E. A. Schwarz); Brownsville, Texas, Apr. 27 (C. H. T. Townsend); Washington, D.C., July 20 (A. Busck)." The last reference, Washington, is obviously in error. Dyar further stated: "The Texas specimens are pale, the ground color an ashy white, on which the dark specks and streaks show plainly. The specimen from Oracle, Ariz., is very dark, the black markings predominating." The pale specimens from Texas, mentioned above by Dyar, are undoubtedly examples of the following new subspecies, *griseus capitatus*.

Meyrick described *Acrolophus leucallactis* as a new species in 1919. He based his description on three specimens, including both sexes, collected in July at Nogales, Arizona. The wing expanse was listed at 19–20 mm. Since 1919 *leucallactis* has appeared in the literature as a distinct species.

The ♂ and ♀ types of *leucallactis* are at the British Museum (Natural History). Mr. Tams has sent me photographs showing all three moths in dorsal aspect and the genitalia of the ♂ in ventral aspect. These agree with the corresponding photographs representing Walsingham's older species, *griseus*, the ♂ and ♀ types of which are also at that institution. The two photographs of the genital capsules of *griseus* and *leucallactis* are almost identical. There is nothing in Meyrick's description of *leucallactis* to indicate that it could not be *griseus*. Thus *leucallactis* Meyrick should be considered a new synonym of *griseus* which is treated here as a new combination, *Acrolophus griseus griseus* (Walsingham).

2b. *Acrolophus griseus capitatus*, new subspecies

FIGURE 35

FEMALE.—Unknown.

MALE.—Head, labial palpi, antennae, and thorax ashy white. Labial palpi elongate, recurved back over head and extending to posterior margin of thorax, closely appressed to head and to each other, densely clothed with large scales. Eyes large, protruding, naked, without lashes. Antennae simple, laminate, covered dorsolaterad with short scales, segmental processes set closely together throughout antennae. Forewings with ground color ashy white, markedly lighter than those of *griseus griseus*, sparsely and irregularly furnished with spots and bars of fuscous scales; markings in form of short bars along basal half of costa, distinct spot at outer end of cell, slender bar above center of fold, and diffused patch below center of fold. Hindwings brown, fringes grayish white. Legs and abdomen pale brown. Wing expanse: 22 to 28 mm.

MALE GENITALIA.—The genitalia, except for the cucullus of the harpe, are so similar between *griseus capitatus* and its companion subspecies *griseus griseus* that the foregoing description of the latter's genital structures should largely suffice for both. Those specimens representing *g. capitatus* exhibit a type of cucullus shown in figure 35, whereas my few specimens of *g. griseus* possess the type of cucullus shown in figure 30. In *g. capitatus*, the cucullus constitutes a relatively greater portion of the total length of the harpe, its basal and central portions are much narrower, and only its approximate apical third is broadly and evenly expanded dorsad and ventrad. A single dissection has revealed these additional, although less marked, genital differences in *g. capitatus:* the furcae of the uncus are very narrowly separated throughout their entire lengths, the apex of the gnathos is emarginate, and the spinelike process constituting the apex of the aedeagus is rather short and very stout. A number of other minor differences, such as those of setal arrangement, occur between the two subspecies.

TYPE.—Holotype ♂ (type no. 61433) in the U.S. National Museum.

PARATYPES.—(7 ♂♂) Illinois State Natural History Survey (6 ♂♂); U.S. National Museum (1 ♂).

TYPE LOCALITY.—Kerrville, Kerr Co., Tex. (June 1910, H. Lacey).

DISTRIBUTION.—Southwestern United States. Texas.

SPECIMENS EXAMINED.—8 (all ♂♂), from 2 localities:

TEXAS: Kerrville, Kerr Co., ♂ (June 1910, H. Lacey), ♂ (May 1911, Lacey); locality and date unknown, 6 ♂♂ ("Tex.," Andreas Bolter Collection).

REMARKS.—This subspecies probably ranges southward and westward into Mexico. As has been shown above, the complex species,

griseus, is not closely related to any other acrolophid. The subspecies, *griseus capitatus*, differs from its close relative, *griseus griseus*, in having a much lighter ground color in the forewings, a differently shaped cucullus of the harpe, and a different geographical distribution.

On the basis of the material at hand, *griseus griseus* and *griseus capitatus* should be considered distinct. However, in the event that transitional forms are found to occur in the intermediate geographical area, New Mexico and northern Mexico, the resulting single species would exhibit an unusual amount of variation in regard to its coloration and the shape of its harpe.

The subspecific name *capitatus* refers to the characteristic headlike or capitate apical portion of the harpe in this subspecies.

3. *Acrolophus texanellus* (Chambers)

FIGURES 36–38

Anaphora texanella Chambers, 1878, Bull. U.S. Geol. & Geogr. Surv. Terr., vol. 4, no. 1, pp. 79, 129, Feb.

Acrolophus texanellus Walsingham, 1887, Trans. Ent. Soc. London, p. 152, pl. 7, fig. 9.—Smith, 1891, List Lep. Bor. Amer., p. 94, no. 5052, p. 112.—Dyar, 1900, Can. Ent., vol. 32, no. 10, p. 308; 1903, List North Amer. Lep., p. 578, no. 6586.—Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8172.—Forbes, 1923, Lep. New York, pp. 120–122, fig. 96.—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 103, no. 9558.

Acrolophus hulstellus Beutenmüller, 1887, Ent. Amer., vol. 3, no. 7, p. 139, Oct.—Smith, 1891, List Lep. Bor. Amer., p. 94, no. 5054.—Dyar, 1900, Can. Ent., vol. 32, no. 10, p. 308; 1903, List North Amer. Lep., p. 578, no. 6587.—Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8173.—Forbes, 1923, Lep. New York, pp. 120, 122.—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 103, no. 9559. (New synonymy.)

Atopocera barnesii Dyar, 1900, Can. Ent., vol. 32, no. 11, p. 326, Nov.; 1903, List North Amer. Lep., p. 578, no. 6590. (New synonymy.)

Acrolophus barnesi Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8179.—Eyer, 1924, Ann. Ent. Soc. Amer., vol. 17, no. 3, p. 315.—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 103, no. 9565.

Chambers' original description follows:

Anaphora texanella.—Very distinct from *plumifrontella*, *popeanella*, and *arcanella* Clem., and from *agrotipenella* and *mortipenella* Grote, nor can I recognize it at all in either *Scardina* or *Bombycina* as described by Zeller.

Palpi overarching the thorax; dark brown on the outward, luteous-brown on the inner surfaces. Antennae compressed, straw-yellow; thorax dark gray-brown; fore wings brown, tinged with grayish-yellow; the usual spot at the end of the disk indistinct; the other spots common to the wings of the other species I cannot find in this. One of them may be represented by an indistinct blackish line beneath the middle of the fold. Hind wings and abdomen fuscous-gray, like the thorax, and a little darker or rather less yellowish than the fore wings. Under surface of both wings grayish-fuscous. Smaller than any specimens that I have seen of the other species, having an alar expansion of only nine lines. Bosque County, Texas. [Nine lines=about 19 mm.]

Walsingham (1887) quoted Chambers' original description and stated:

> To this I may add that the antennae are compressed, flattened, having a roughened or serrated appearance caused by lines of slightly raised scales around each joint. The apical vein of the fore wing is not forked. The lateral claspers are narrow, elongate, slightly upturned from near the base, but straightened beyond, not spoon-shaped, but evenly rounded and slightly inverted at the apex. The uncus is double, straight, the points scarcely at all bent over, very short, not closely approximate, slightly diverging.

Walsingham also figured a dorsal view of the uncus and a lateral view of the uncus and cucullus for this species.

MALE GENITALIA.—Vinculum typical, as in other species.

Tegumen glabrous; lateral arm rather elongate and broad, margins sublinear and gradually converging toward point of articulation with vinculum; dorsal area of medium width, not separated along meson.

Harpe simple. Lateral aspect: sublinear, approximate apical half considerably narrower than basal half; costa and sacculus fused, linear, comprising approximate basal half of harpe; glabrous except for sparsely punctate and setose, angulate, ventrocaudal margin of sacculus; broadest in apical third, approximate basal half gradually narrowing basad, basal extremity rather narrowly rounded; cucullus set off from costa and sacculus by dorsal and ventral constrictions and by area of reduced sclerotization, comprising approximate apical half of harpe, commonly directed slightly ventrad, dorsal portion of basal two-thirds glabrous, major portion becoming increasingly punctate and setose ectad and entad toward apex, rather slender, about two-thirds as broad as costa and sacculus, gradually narrowing toward rather narrowly rounded apex, dorsal margin sinuate, ventral margin linear to minutely sinuate in basal half and minutely sinuate in apical half; slender area extending along ventral margin markedly reduced in thickness and with smooth, glassy appearance.

Transtilla with arm of medium length and width, well sclerotized, glabrous, slightly diverging from to strongly converging toward dorsal margin of costa, terminating acutely or subacutely at or near basal extremity of harpe.

Uncus bifid. Dorsal aspect: base largely set off from tegumen by areas of reduced sclerotization, heavily punctate and setose except along meson, cephalic margin evenly emarginate mesad; lateral margins very heavily sclerotized, sublinear, gradually converging distad; angle of bifurcation rather broad, evenly rounded; furcae short, of medium width, tubular, punctate and setose, slightly diverging and curving ventrad toward apices, narrowing distad, apices finely acute.

Gnathos typically paired, directed ventrocaudad, lateral margins very heavily sclerotized; arms subparallel, approximate, weakly scobinate entad, with apices narrowly but evenly rounded.

Anellus rather large, ventral portion membranous and unarmed; juxta absent but dorsal portion noticeably thickened and darkened by increased sclerotization, with distinct longitudinal ridges, and concave beneath.

Aedeagus rather elongate and slender, approximately five-sixths as long as harpe, cylindrical, asymmetrical, sublinear in dorsal and ventral aspect, small basal portion and approximate apical two-fifths curving markedly ventrad in lateral aspect, base moderately expanded ventrad, central portion commonly armed ventrolaterad with scattering of minute spinelike processes, approximate apical third gradually and increasingly opening dextrad toward apex, apical quarter slightly expanded, apex very narrowly but evenly rounded

Vesica of medium size, bulbous, membranous, unarmed.

TYPE.—Type ♂ in the Museum of Comparative Zoology (not seen).

TYPE LOCALITY.—Bosque Co., Tex.

DISTRIBUTION.—Central and eastern United States. Kansas and Texas eastward to Maryland and Florida.

SPECIMENS EXAMINED.—44 (35 ♂♂, 9 ♀♀), from 18 localities:

FLORIDA: Florida City, ♂ (Oct. 28, 1938, Brower Collection); Port Sewall, ♂ (Nov. 16–18, 1938, F. E. Watson & L. J. Sanford); Winter Park, ♂ (July 1946, A. B. Klots). GEORGIA: Rabun Co., ♂ (June 26, 1927, A. G. Richards, Jr.), 2 ♂♂, ♀ (July 13, 1928, Richards); Spring Creek, Decatur Co., ♂ (June 7–23, 1911, J. C. Bradley). ILLINOIS: Chicago, ♂ (July 16, 1946, A. K. Wyatt); Putnam Co., ♂ (July 19, 1942, M. O. Glenn); Urbana, ♂ (summer, 1947, from light globe, F. F. Hasbrouck). KANSAS: Douglas Co., 3 ♂♂, ♀ (July 17–22, 1940, Fritz Forbes). MARYLAND: Plummer's Island, ♀ (July 18, G. P. Engelhardt). MISSOURI: Kirkwood, ♀ (July 17, 1905, M. E. Murtfeldt), ♂ (July 27, 1907, Murtfeldt), ♂, ♀ (July 10, 1910, Murtfeldt). NORTH CAROLINA: Brevard, 3 ♂♂, ♀ (July 19–31, 1942, M. J. Westfall, Jr.); Maxton, ♂ (May 20, 1944, A. B. Klots), ♂ (no date, Klots). OKLAHOMA: Wyandotte, ♀ (June 19, 1939, Kaiser-Nailon). SOUTH CAROLINA: Greenville, ♂ (July 5, 1931, Henry Townes). TEXAS: Brownsville, ♀ (May 29, 1932, J. O. Martin), 2 ♂♂ (June, F. H. Snow), 3 ♂♂, ♀ (June, collector unknown); Kingsville, 3 ♂♂ (June 8, 1936); Victoria, ♂ (June 24, 1917); locality unknown, 5 ♂♂ ("Tex.," Andreas Bolter collection).

REMARKS.—This old species, although widely distributed, is apparently only locally common. Its considerable variation in size and color pattern undoubtedly accounts for its two synonyms. The material representing *texanellus* was received on loan from ten sources, with Cornell University furnishing about one-third of the specimens in a series of 11 ♂♂ and 4 ♀♀.

A. texanellus is related to those acrolophids having elongated labial palpi and setose eyes, from which species it may be separated by its distinctive unipectinate antennae, each segment of which is completely

encircled by a ring of scales. Although not forming a species group with any other acrolophid, *texanellus* exhibits certain affinities with *propinquus* in regard to general habitus, genital structure, and geographical distribution. However, the two species may be easily separated on the basis of antennal structure and less easily by differences in genital structure and the generally smaller size of *texanellus*. Although the genital characters of *texanellus* are both distinctive and consistent throughout my series, the size and general habitus of the moth vary considerably over its rather wide geographical range.

The type ♂ of *A. hulstellus*, in the U.S. National Museum, is labeled "type no. 403, Indian River, Florida, Beutenmueller Collection," and is equivalent to my conception of *texanellus* on the basis of its genital and antennal structure. The antennae are both unusual and characteristic in approaching a unipectinate condition while having each segment completely encircled by a ring of scales. Also in the U.S. National Museum is a slide of ♂ genitalia, labeled "*Acrolophus hulstellus* Beut., Plummers Isl., Md., Coll. A. Busck," which I found to be identical with my conception of the ♂ genitalia of *texanellus*. Thus, *hulstellus* Beutenmüller should be considered a new synonym of *texanellus* (Chambers).

The description of Dyar's *Atopocera barnesii* was based on a single ♂ specimen from Kerrville, Tex. The wing expanse was listed at 20 mm. Presumably it was named after Dr. William Barnes, from whom the specimen was received. The type, at the U.S. National Museum, is labeled "type no. 5347, Kerrville, Texas." Its genitalia were removed and mounted on a slide by August Busck on Oct. 11, 1933. After examining the moth and the slide, I was able to confirm the identity of *barnesi*, which, like the type of *hulstellus*, is equivalent to my conception of *texanellus*. Thus, *barnesi* (Dyar) should be considered a new synonym of *texanellus* (Chambers).

4. *Acrolophus acornus*, new species

FIGURES 39–42

MALE.—Head, labial palpi, antennae, and thorax ochreous suffused with fuscous. Labial palpi elongate, recurved back over head and extending to or slightly beyond center of thorax, closely appressed to head and to each other although not appressed to thorax, very densely clothed with scales. Eyes large, protruding, rather densely setose, weakly lashed. Antennae simple, with each segment globose and completely encircled by distinct ring of scales. Forewings with variable coloration, commonly pale brown and indistinctly suffused with ochreous patches. Hindwings and fringes brown. Abdomen ochreous. Wing expanse: 14 to 17 mm.

FEMALE.—Coloration similar to that of ♂. Labial palpi rather long, porrect, closely appressed, densely clothed with large scales. Eyes somewhat smaller than those of ♂ but otherwise similar. Antennae simple, slender, completely covered by scales. Forewings more elongate and slender than in ♂, with apices subacute. Wing expanse: 19 mm.

MALE GENITALIA.—Vinculum typical, as in other species.

Tegumen glabrous; lateral arm broad, narrowing at point of articulation with vinculum; dorsal area very broad, not separated along meson.

Harpe simple. Lateral aspect: sublinear, quite slender, with ventral expansion near center, capitate; costa and sacculus fused, glabrous except for punctate and setose ventrocaudal margin of sacculus, apical area expanded ventrad, dorsal margin with small expansion distad of base of arm of transtilla, narrowing considerably to base; cucullus fairly distinct from costa and sacculus, comprising somewhat less than apical half of harpe, heavily punctate and setose ectad and entad, basal third narrow, apical two-thirds considerably expanded ventrad, broadest portion near apex almost twice width of basal area, dorsal margin curving slightly dorsad toward apex, apex broadly and rather irregularly rounded.

Transtilla with arm elongate, slender, glabrous, apical third curving ventrad to overlap costa, terminating subacutely near base of harpe.

Uncus simple, almost identical with that of *bicornutus*; base subtriangular, fused with tegumen, heavily punctate, lateral margins sublinear and converging distad into base of uncal process; uncal process of medium length, tubular, sparsely punctate and setose, curving slightly ventrad toward apex, apex minutely and acutely bifid.

Gnathos fused, same as that of *bicornutus*; in form of moderately sclerotized flap directed ventrocaudad, lateral margins weakly sinuate and converging distad to form broadly rounded apex, ental surface of apex finely pitted.

Anellus membranous, unarmed, juxta absent.

Aedeagus of medium length, slender, glabrous, asymmetrical, approximately linear in dorsal and ventral aspects, basal and apical portions curving slightly ventrad in lateral aspect, base moderately expanded, basal two-thirds cylindrical, apical third opening dorsad; apex produced into small, acute, minutely dentate process.

Vesica small, membranous, unarmed.

TYPE.—Holotype ♂ (type no. 61434) in the U.S. National Museum.

PARATYPES (5 ♂♂, 1 ♀).—American Museum of Natural History (1 ♂, 1 ♀), California Academy of Sciences (1 ♂), Cornell University (1 ♂), U.S. National Museum (1 ♂), University of Kansas (1 ♂).

TYPE LOCALITY.—Palmerlee, Cochise Co., Arizona (date and collector unknown).

DISTRIBUTION.—Southwestern United States. Southern Arizona.

SPECIMENS EXAMINED.—7 (6 ♂♂, 1 ♀), from 5 localities:

ARIZONA: Oracle, Pinal Co., ♂ (July 28, 1924, E. P. Van Duzee); Palmerlee, Cochise Co., ♂ (date and collector unknown); Pima Co., "30 miles east of Quijotoa," ♂ (Aug. 28–29, 1927, collector unknown); San Bernardino Ranch, Cochise Co., 2 ♂♂ (Aug., elevation 3750 feet, F. H. Snow); Tucson, Pima Co., ♂, ♀ (July 30, 1937, A. B. Klots).

REMARKS.—The ♀ listed above probably belongs to *acornus*, although I am not absolutely certain of its correct identity. This species undoubtedly ranges southward into Mexico. It is closely related to *simulatus* and *bicornutus*, with which it forms a distinct species group. This group, as characterized in the key, consists of small moths having elongate labial palpi, setose eyes, globose antennal segments completely encircled by rings of scales, and a type of uncus consisting of a single process minutely and acutely bifid at the extreme apex.

A. acornus may be distinguished from its close relatives, as well as from all other acrolophids, by its characteristic harpe and aedeagus. The name *acornus* refers to the absence of cornuti in the vesica of the aedeagus of this species.

5. *Acrolophus simulatus* Walsingham

FIGURES 43–45

Acrolophus (?) *simulatus* Walsingham, 1882, Trans. Amer. Ent. Soc., vol. 10, p. 168, Nov.; 1887, Trans. Ent. Soc. London, p. 148, pl. 7, fig. 7.—Smith, 1891, List Lep. Bor. Amer., p. 94, no. 5047.—Dyar, 1900, Can. Ent., vol. 32, no. 10, p. 308; 1903, List North Amer. Lep., p. 578, no. 6589.—Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8175.—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 103, no. 9561.

Walsingham's original description follows:

Acrolophus (?) *simulatus*—Head rough; maxillary palpi none; tongue none; ocelli none. Labial palpi recurved over the head and part of the thorax; the second joint very long, roughly clothed with projecting scales beneath; third joint about half as long as the second, brushlike, with very long diverging scales on the underside. Antennae strong, slightly pubescent, somewhat serrated on both sides, especially towards the apex. The anal appendages in the male much developed, the elongated ovate side claspers not reaching beyond the upper shield, which is triangular and pointed. Fore wings with the costa arched, apex rounded, apical margin oblique, slightly convex, the dorsal margin somewhat convex, not emarginate before the rounded anal angle. Hind wings ovate, wider than the fore wings. Fore wings with twelve separate veins. The vein from the upper corner of the discal cell in the fore wings ends on the costal margin and is not forked; cell of hind wings not closed. Alternate brown and whitish ochreous patches along the costal and dorsal halves of the fore wings, the paler portions apparently predominating rather more than in *Eulepiste cressoni*, the darker portions assuming the form of two angulated fasciae; there are numerous raised

bluish fuscous scales scattered especially about the darker patches. Hind wings and cilia dull brown. Expanse 15 millims.

Six specimens in the collection of the American Entomological Society of Philadelphia, unfortunately all of them in very bad condition. So far as I can judge, the markings and colour are almost exactly similar to those of the following species (*cressoni*), also from Texas.

Walsingham (1887) later furnished an illustration of the uncus and cucullus of the ♂ genitalia in dorsolateral aspect for this species. He also commented:

To the description of this species I should wish to add that the antennæ are not strictly serrated in structure, but have a serrated appearance caused by rings of slightly elevated scales. The lateral claspers slender, attenuated near the base, dilated downwards beyond; their upper edge being nearly straight, the tapering ends evenly rounded and slightly bent inwards. The uncus is single, with the point short and very little bent over. On re-examination of the cell of the hind wings I find a slender nervure closing it at the end.

MALE GENITALIA.—Vinculum typical, as in other species.

Tegumen glabrous; lateral arm narrow, narrowing further at point of articulation with vinculum; dorsal area narrow, not separated along meson.

Harpe simple. Lateral ectal aspect: elongate, sublinear, rather slender, with ventral expansion near center. Lateral ental aspect: sacculus with very large, rounded, glabrous, dorsal expansion evenly curving cephalodorsad well beyond arms of tegumen and transtilla and finally curving cephaloventrad to base of harpe. Lateral aspect: costa and sacculus fused, elongate, with apical portion considerably expanded ventrad, narrowing to base. Cucullus distinct from costa and sacculus, comprising approximate apical two-fifths of harpe, heavily punctate and setose ectad and entad, gradually curving mesad toward apex, basal third narrow, central third somewhat expanded ventrad, apical third narrowing distad, dorsal margin sublinear, apex evenly rounded.

Transtilla with arm rather elongate, glabrous, subparallel with dorsal margin of costa, apical portion somewhat expanded and curving toward costa, terminating slightly distad of base of harpe.

Uncus simple, same as that of *bicornutus*. Dorsal aspect: base with cephalic margin weakly emarginate mesad, laterobasal areas heavily punctate, lateral margins sublinear and converging distad to base of uncal process. Uncal process of medium length, tubular, sparsely punctate and setose, curving slightly ventrad, apex minutely and acutely bifid.

Gnathos fused, same as that of *bicornutus;* in form of moderately sclerotized flap directed ventrocaudad, lateral margins weakly sinuate and converging distad to form broadly rounded apex, ental surface of apex finely pitted.

Anellus membranous, unarmed, juxta absent.

Aedeagus of medium length, slender, cylindrical, asymmetrical, sublinear in dorsal and ventral aspects, apical half curving evenly ventrad through angle of approximately 75° in lateral aspect, width nearly constant throughout except at base and apex, base moderately and irregularly expanded cephaloventrad, approximate apical fourth narrowing and opening dextrad, apex acute; median dextral area basad of opening with or without single row of approximately six to twelve, minute, acute spines of various sizes.

Vesica small, membranous, apex acute, ventral surface armed with single row of approximately six to sixteen cornuti. Cornuti rather small, nearly uniform in size, acute, directed distad, merging with much smaller spines (when present) of aedeagus to form continuous row.

TYPE.—Type ♂ in the British Museum (Natural History). Additional type material at the Academy of Natural Sciences of Philadelphia.

TYPE LOCALITY.—"Texas."

DISTRIBUTION.—Texas eastward to Florida and northward to North Carolina.

SPECIMENS EXAMINED.—56 (all ♂♂), from 3 localities:

FLORIDA: Gainesville, ♂ (June 2, 1927, traplight, J. S. Rogers), 43 ♂♂ (June 3, 1927, traplight, Rogers), ♂ (June 29, 1927, traplight, Rogers), ♂ (July 7, 1927, traplight, Rogers). All specimens from Cornell University collection. NORTH CAROLINA: Maxton, ♂ (May 16, 1944, A. B. Klots), ♂ (May 20, 1944, Klots), ♂ (no date, Klots). Specimens from American Museum of Natural History. TEXAS: Locality and date unknown, 7 ♂♂ ("Tex.," Andreas Bolter collection).

REMARKS.—*A. simulatus* should also be found in South Carolina, Georgia, Alabama, Mississippi, and Louisiana. Dyar, in 1903, reported this species from Arizona as well as from Texas; however, I have seen no examples of *A. simulatus* from Arizona. It probably ranges southward into Mexico. It is closely related to *acornus* and *bicornutus*, with which it forms a species group. This group has been characterized in the key and in the foregoing remarks on *acornus*. *A. simulatus* may be distinguished from its close relatives, as well as from all other acrolophids, by its characteristic harpe and aedeagus.

Mr. Tams of the British Museum (Natural History) has sent me photographs labeled "*simulatus* Wals., type," showing the adult ♂ and its genitalia, that confirm the identity of this species. Dr. E. P. Darlington, in a letter, 1946, has reported an additional type specimen of this species at the Academy of Natural Sciences of Philadelphia as follows: "*simulatus* Wlsh. Type. Left wings and right hind wing intact, much rubbed, sex not determined." The original description of *simulatus* represents the first instance in which the generic name, *Acrolophus*, was applied to a North American species.

6. *Acrolophus exaphristus* Meyrick, *incertae sedis*

Acrolophus exaphrista Meyrick, 1919, Exotic Microlep., vol. 2, no. 10, p. 279, Nov.—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 103, no. 9572.

Meyrick's original description follows:

Acrolophus exaphrista—♂. 16 mm. Head, palpi, thorax dark fuscous; palpi extremely long, recurved, reaching to beyond thorax, thickened with dense rather rough scales throughout, broadly expanded at apex, joints of nearly equal length. Antennae simple, shortly ciliated. Abdomen grey; uncus moderate, single, slender, acute, rising from a triangular plate; valvae narrow, dilated terminally, angles well-marked, terminal edge slightly curved. Forewings elongate, costa gently arched, apex obtuse, termen rather obliquely rounded; 3 absent; rather dark fuscous, somewhat mottled light brownish on costal half, especially along costa; numerous small scattered dots on veins of raised blackish scales, anteriorly white; round brownish-ochreous spots suffusedly irrorated whitish on fold at ⅓ and in disc at ¾: cilia fuscous. Hindwings and cilia grey.

Florida; one specimen. In this species the uncus appears to be truly single, not merely with the two processes closely appressed.

A. exaphristus, based on a single ♂ specimen from Florida, is here treated as *incertae sedis*. The type, in the British Museum (Natural History), has not been available to me for study. Photographs furnished me by Mr. Tams and Dr. Clarke show the genitalia in ventral aspect, the aedeagus, and a dorsal view of the pinned specimen prior to dissection. Collectively they present a combination of characters I have yet to observe in a North American specimen of *Acrolophus*.

After reading the original description, I first thought *exaphristus* belonged to the *simulatus* species group and might even prove to be *simulatus* itself. However, the photographs of the genitalia indicate that this is not the case. In the *simulatus* group, the uncus is minutely bifid at the apex, the gnathos is fused into a single flap, and the cucullus of the harpe is shaped differently from the one shown in the photographs of *exaphristus*.

From the information available, *exaphristus* may be briefly diagnosed as follows: small, labial palpi elongate, antennae "simple," uncus single, gnathos paired, cucullus of harpe with apical portion expanded, aedeagus linear but with base considerably expanded and emarginate. The photograph of the aedeagus indicates that the vesica may be armed with several small, apical cornuti.

7. *Acrolophus bicornutus*, new species

FIGURES 46–48

MALE.—Head, labial palpi, antennae, and thorax ochreous suffused with fuscous. Labial palpi elongate, recurved back over head and extending to or slightly beyond center of thorax, closely appressed to

head, diverging from thorax distad, heavily clothed with scales. Eyes large, protruding, rather densely setose, moderately lashed with elongate setae. Antennae simple, with each segment globose and completely encircled by distinct ring of scales. Both forewings and hindwings brownish, with little or no color pattern, fringes slightly paler. Abdomen pale brown. Wing expanse: 11 to 16 mm.

FEMALE.—Coloration similar to that of ♂ although generally paler. Labial palpi short, partially recurved, diverging from head and from each other distad, densely clothed with scales. Eyes fairly large but less protruding than in ♂, moderately setose, weakly lashed. Antennae simple, slender, completely covered by scales. Wing expanse: 19 mm.

MALE GENITALIA.—Vinculum typical, as in other species.

Tegumen with lateral arm broad but narrowing sharply near point of articulation with vinculum, sparsely punctate along dorsocaudal margin; dorsal area rather narrow, not separated along meson.

Harpe simple. Lateral aspect: slender, somewhat constricted near center, apical two-fifths curving somewhat ventrad; costa and sacculus fused, glabrous except for punctate and setose ventrocaudal margin of sacculus, apical portion considerably expanded ventrad, approximate basal half narrowing somewhat toward base, basal extremity rounded; cucullus fairly well set off from costa and sacculus by ventral constriction near base, comprising approximate apical half of harpe, rather slender, heavily punctate and setose ectad and entad, apical four-fifths curving noticeably ventrad, apical half slightly expanded and with dorsal and ventral margins subparallel, apex evenly rounded.

Transtilla with arm of medium length, rather slender, glabrous, subparallel with to considerably divergent from dorsal margin of costa, terminating acutely considerably distad of basal extremity of harpe.

Uncus simple, except at extreme apex. Dorsal aspect: base with cephalic margin weakly emarginate mesad, laterobasal areas heavily punctate, lateral margins sublinear and converging distad into base of uncal process; uncal process of medium length and width, tubular, sparsely punctate and setose, curving somewhat ventrad toward apex, extreme apex minutely and acutely bifid.

Gnathos fused, in form of moderately sclerotized flap directed ventrocaudad, lateral margins weakly sinuate and converging distad into broadly rounded apex, dorsal surface of apex finely pitted.

Anellus large, membranous, unarmed, juxta absent.

Aedeagus rather large in comparison with other genital structures, asymmetrical, glabrous, basal extremity weakly expanded, base curving considerably ventrad, basal two-fifths cylindrical, approximate apical three-fifths broadly opening dorsad and gradually curving

ventrad toward apex; apex almost spinelike, acute, heavily sclerotized, directed somewhat ventrad.

Vesica large, membranous, armed with pair of large cornuti: cornutus nearest base of vesica large, linear, heavily sclerotized, acute, with base expanded and fusing with large irregular mass of partially sclerotized tissue embedded in vesica; cornutus nearest apex of vesica similar but only one-third to two-thirds as large, embedded in larger and more elongate area of partial sclerotization to completely lacking this irregular basal area.

TYPE.—Holotype ♂ (type no. 61435) in the U.S. National Museum.

PARATYPES(16 ♂♂).—American Museum of Natural History (4 ♂♂); Cornell University (7 ♂♂); Illinois State Natural History Survey (3 ♂♂); U.S. National Museum (2 ♂♂).

TYPE LOCALITY.—Lake Alfred, Polk Co., Fla. (July 13, 1928, at light, L. J. Bottimer).

DISTRIBUTION.—Kansas and Texas eastward to Florida.

SPECIMENS EXAMINED.—18 (17 ♂♂, 1 ♀), from 6 localities:

FLORIDA: Lake Alfred, Polk Co., 2 ♂♂ (July 13, 1928, at light, L. J. Bottimer). KANSAS: Onaga, Pottawatomie Co., 2 ♂♂ (June 17 and 22, 1901, at light, F. F. Crevecoeur), ♂ (July 13, 1901, Crevecoeur), ♂ (no date, Crevecoeur). TEXAS: Corpus Christi, Nueces Co., ♂ (May 14, 1943, at light, W. M. Gordon), ♂ (Sept. 2, 1943, at light, Gordon), 3 ♂♂, ♀ (Sept. 25–Oct. 15, 1943, Gordon); Kerrville, Kerr Co., ♂ (May 1906, F. C. Pratt); Sanderson, Terrell Co., ♂ (May 16, 1918, J. Ch. Bradley); Uvalde, Uvalde Co., ♂ (May 19, 1918, J. Ch. Bradley); locality and date unknown, 3 ♂♂ ("Tex.," Andreas Bolter collection).

REMARKS.—One of the smallest acrolophids occurring in America north of Mexico, *bicornutus* should be found throughout the Gulf States. In addition, it probably ranges southward and westward into Mexico. The only available ♀ specimen, received from Cornell University, has not been positively associated with the ♂♂ of this species.

A. bicornutus is closely related to *simulatus* and *acornus*, with which it forms the species group characterized in the key and in the foregoing remarks on *acornus*. The members are distinguished from one another, as well as from all other acrolophids, on the basis of their harpes and aedeagi. The latter organ is especially valuable for the separation of these three otherwise similar species. The name *bicornutus* refers to the two characteristic cornuti in the vesica of the aedeagus of this species.

8. *Acrolophus filicicornis* (Walsingham)

FIGURES 49–53

Felderia filicicornis Walsingham, 1887, Trans. Ent. Soc. London, p. 167, pl. 8, figs. 22, 22a, June.—Smith, 1891, List Lep. Bor. Amer., p. 95, no. 5064.—Dyar, 1903, List North Amer. Lep., p. 579, no. 6599.

Felderia filicornis Dyar, 1900, Can. Ent., vol. 32, no. 10, p. 310 (name misspelled); 1903, List North Amer. Lep., p. 579, no. 6599 (Dyar here lists his previous misspelling as a second synonym of *filicicornis*).

Acrolophus mexicanellus (♀) Beutenmüller, 1888, Ent. Amer., vol. 4, no. 2, p. 29, May (originally described from Mexico).—Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8190 (syn.).—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 104, no. 9580 (syn.).

Felderia filicicornis mexicanellus Smith, 1891, List Lep. Bor. Amer., p. 95, no. 5064a.

Felderia mexicanellus Dyar, 1900, Can. Ent., vol. 32, no. 10, p. 310 (syn.); 1903, List North Amer. Lep., p. 579, no. 6599 (syn.).

Acrolophus filicicornis Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8190.—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 104, no. 9580.

Acrolophus filicornis Eyer, 1924, Ann. Ent. Soc. Amer., vol. 17, no. 3, p. 315 (name misspelled).

Walsingham's original description follows:

Felderia filicicornis—Labial palpi strongly recurved, reaching to the posterior margin of the thorax. *Antennae* strongly bipectinate, the pectinations being slightly narrower at their bases, wider outwardly, subochreous. *Head, thorax, and palpi* thickly clothed with fuscous hair-like scales, tipped with hoary white. *Fore wings* mottled greyish and brownish fuscous; about twelve brownish fuscous ill-defined dots along the costal margin, not arranged in pairs, but distributed at approximately equal distances; a brownish fuscous spot at the end of the cell, from which a streak of the same colour extends obliquely downwards to the anal angle; fringes greyish fuscous, speckled with whitish. *Hind wings* brownish, with a faint purplish tinge; fringes pale greyish brown. *Abdomen* brownish. *Under side of all the wings* pale cinereous, the costal margin of the fore wings not defined by a pale line as in *arizonella*. *Exp. al.* ♂, 26 mm.; ♀, 27–31 mm. The lateral claspers of the male spoon-shaped, widened in the middle, tapering outwardly, and rounded at the apex; the uncus double, the two points parallel, shorter and wider apart than in *arizonellus*.

Hab. One male and five females from Arizona, collected by Morrison.

This species has much the appearance of *arizonella*, Wlsm., but the peculiar form of the antennae in the male at once serves to distinguish it.

Walsingham's illustrations consisted of figure 22, the uncus and cucullus of the harpe in dorsolateral aspect, and figure 22a, the ♂ antenna in dorsolateral aspect.

MALE GENITALIA.—Vinculum typical, as in other species.

Tegumen typical, glabrous, not separated along meson.

Harpe simple. Lateral aspect: linear, constricted near center. Costa and sacculus fused, comprising slightly more than basal half of harpe, approximate apical half broad and somewhat expanded dorsad, basal half approximately half as broad as apical half and with dorsal and ventral margins subparallel, basal extremity broadly and evenly rounded. Cucullus set off from costa and sacculus by constrictions and area of reduced sclerotization, rather broad; ectal surface strongly convex, heavily punctate and setose; ental surface strongly concave, rather weakly punctate and setose; basal half slightly narrowed, apical

half somewhat expanded ventrad, apical third directed strongly mesad, apex broadly and irregularly rounded.

Transtilla with arm of medium length, rather slender, linear, glabrous, converging to dorsal margin of costa, terminating acutely slightly distad of basal extremity of harpe.

Uncus bifid. Dorsal aspect: base heavily punctate and setose especially nearest cephalic margin, cephalic margin fused to tegumen, lateral margins sublinear and moderately convergent distad; angle of bifurcation broad and with or without small, rounded, mesal projection; furcae rather short, robust, conical, setose, broadly separated, gradually narrowing and diverging distad, directed somewhat ventrad, apices acute.

Gnathos paired; arms rather small, well sclerotized, rather narrowly separated, slightly to strongly convergent distad, apical portions commonly overlapping, apical thirds weakly and minutely pitted entad, apices narrowly rounded.

Anellus large, membranous, unarmed, juxta absent.

Aedeagus rather elongate and slender, asymmetrical, weakly sinuate, basal and apical portions directed somewhat ventrad in lateral aspect, base moderately expanded ventrad, basal three-fifths slender and cylindrical, apical two-fifths gradually expanding distad, approximate apical fourth opening broadly dextrad; apex bluntly and irregularly rounded laterad, with process arising from dorsal margin. Dorsal process consisting of rather elongate, slender, moderately sclerotized, acute projection partially and indistinctly fusing with adjacent vesica and curving strongly ventrad toward apex; armed from base to apex with irregular row of approximately 20–35 minute, acute spines directed distad and becoming progressively larger distad.

Vesica rather large, membranous, dorsal surface unarmed or with several minute cornuti, dextral and ventral surfaces densely armed with 100 or more cornuti; cornuti minute, all approximately equal in size, well sclerotized, with apices acute and blackened, pointing in all directions.

TYPE.—♂ and ♀ types in the British Museum (Natural History).

TYPE LOCALITY.—"Arizona."

DISTRIBUTION.—Southwestern United States and Mexico. Arizona and Texas southward into Mexico.

SOURCES OF MATERIAL.—American Museum of Natural History (3 ♂♂, 2 ♀♀); California Academy of Sciences (1 ♀); Carnegie Museum (1 ♀); Cornell University (1 ♂); Denison University (2 ♂♂, 1 ♀); Ohio State University (3 ♂♂, 1 ♀).

SPECIMENS EXAMINED.—15 (9 ♂♂, 6 ♀♀), from 10 localities:

ARIZONA: Boulder Springs, Mohave Co., ♂ (July 1–15, 1921, O. C. Duffner); Elgin, ♂, ♀ (July 17, 1948, C. & P. Vaurie); Huachuca Mountains, 2 ♂♂, ♀

(July 20, 1937, D. J. & J. N. Knull); Hualapai Mountains, ♂, ♀ (July 15–30, 1921, O. C. Duffner); Oracle, ♀ (July 28, 1924, E. P. Van Duzee); Paradise, Cochise Co., ♀ (July, O. C. Poling); Patagonia, ♂, ♀ (July 18, 1948, C. & P. Vaurie). TEXAS: Davis Mountain, ♂ (Aug. 2, 1937, D. J. & J. N. Knull); Fort Davis, ♂ (July 2, 1948, C. & P. Vaurie); Valentine, ♂ (July 7, 1917, collector unknown).

REMARKS.—This species is here recorded from Mexico on the basis of its synonym, *mexicanellus* Beutenmüller, the holotype ♀ of which was collected in Mexico City. *A. filicicornis* is related to those species having elongate labial palpi, setose eyes, and strongly bipectinate antennae. However, it is not closely related to any other acrolophid. It may be easily separated from its nearest relatives on the basis of its distinctive color pattern, uncus, harpe, and aedeagus. In appearance, *filicicornis* is one of the more robust members of the genus.

Photographs furnished me by Mr. Tams of the British Museum (Natural History), labeled "*filicicornis* Wals., type," show the adult ♂ and ♀ and their respective genitalia and confirm the identity of this species. Dyar (1900) listed the following distributional data for *filicornis*: "Oracle, Arizona, July 12 (E. A. Schwarz); Fort Grant, Arizona, July 20 (H. G. Hubbard); Brownsville, Texas, June 10 (C. H. T. Townsend)."

Beutenmüller described *A. mexicanellus* in 1888 as a new Mexican species. Following the description, he stated: "This species has a superficial resemblance to *Acrolophus hulstellus*, Beut., but may be readily distinguished from it by being a much larger heavier insect, and also by the rounded apices of the wings. Expanse of wings 30 mm. 1 ♀. Taken by Mr. Julius Mohn in the City of Mexico."

In 1891, Smith placed *mexicanellus* as a subspecies of the slightly older species, *Felderia filicicornis* Walsingham, by presenting the trinomial, *Felderia filicicornis mexicanellus*, in his check list.

In 1900, Dyar properly placed "*Mexicanellus*" as a synonym of "*Felderia filicornis*, Walsingham," despite his misspelling. Since that date, *mexicanellus* has consistently appeared in the literature as a synonym of *filicicornis*.

The type ♀ of *A. mexicanella*, in the U.S. National Museum is labeled "type no. 408, Mexico City, Mexico, Beutenmueller Collection," and I find no differences between this specimen and my series of ♀♀ previously determined as *filicicornis*. Thus, *mexicanellus* (♀) Beutenmüller should be considered an old synonym of *filicicornis* (Walsingham) with Dyar receiving the credit for its placement.

9. *Acrolophus plumifrontellus* (Clemens)

FIGURES 54–58

Anaphora plumifrontella Clemens, 1859, Proc. Acad. Nat. Sci. Philadelphia, p. 261, Sept.; 1872, Tineina of North Amer., pp. vii, 39, 56–57, 60, fig. 3.—Grote, 1872, Can. Ent., vol. 4, no. 8, p. 143.—Zeller, 1873, Verh. zool.-bot. Ges. Wien, vol. 23, p. 217.—Chambers, 1878, Bull. U.S. Geol. & Geogr. Surv. Terr., vol. 4, no. 1, p. 129.

Anaphora bombycina Zeller, 1873, Verh. zool.-bot. Ges. Wien, vol. 23, p. 218, May.—Chambers, 1878, Bull. U.S. Geol. & Geogr. Surv. Terr., vol. 4, no. 1, p. 129.—Walsingham, 1887, Trans. Ent. Soc. London, pp. 149–150 (syn.).

Acrolophus plumifrontellus Walsingham, 1887, Trans. Ent. Soc. London, p. 149, pl. 7, figs. 5–5e.—Beutenmüller, 1889, Ent. Amer., vol. 5, no. 1, p. 9.—Smith, 1891, List Lep. Bor. Amer., p. 94, no. 5048.—Walsingham, 1891, Proc. Zool. Soc. London, pp. 513, 544.—Walsingham, 1897, Proc. Zool. Soc. London, p. 174.—Dyar, 1900, Can. Ent., vol. 32, no. 10, pp. 308–309; 1903, List North Amer. Lep., p. 578, no. 6584.—Holland, 1903, Moth Book, p. 443, pl. 48, fig. 43.—Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8170.—Barnes & Lindsey, 1921, Contrib. Nat. Hist. Lep. North Amer., vol. 4, no. 4, pl. 40, fig. 6.—Forbes, 1923, Lep. New York, pp. 120, 122, fig. 97.—Eyer, 1924, Ann. Ent. Soc. Amer., vol. 17, no. 3, p. 286 (text fig. I), p. 315, pl. 35, fig. 7.—Eyer, 1926, Ann. Ent. Soc. Amer., vol. 19, no. 2, pp. 244–245, pl. 18, fig. 16.—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 103, no. 9556.

Acrolophus plumifrontellus var. *angustipennella* Beutenmüller, 1887, Ent. Amer., vol. 3, no. 7, p. 140, Oct.

Acrolophus cervinus (♀) Walsingham, 1887, Trans. Ent. Soc. London, p. 151, pl. 7, fig. 6, June.—Smith, 1891, List Lep. Bor. Amer., p. 94, no. 5051.—Dyar, 1900, Can. Ent., vol. 32, no. 10, pp. 308–309 (syn.?).—Dyar, 1903, List North Amer. Lep., p. 578, no. 6585.—Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8171.—Forbes, 1923, Lep. New York, p. 122 (syn.).—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 103, no. 9557.

Acrolophus bombycina Smith, 1891, List Lep. Bor. Amer., p. 94, no. 5048 (syn.).—Walsingham, 1897, Proc. Zool. Soc. London, p. 174 (syn.).—Dyar, 1903, List North Amer. Lep., p. 578, no. 6584 (syn.).—Holland, 1903, Moth Book, p. 443 (syn.).—Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8170 (syn.).—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 103, no. 9556 (syn.).

Acrolophus angustipennellus Smith, 1891, List Lep. Bor. Amer., p. 94, no. 5049.—Dyar, 1903, List North Amer. Lep., p. 578, no. 6585.—Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8171 (syn.).—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 103, no. 9557 (syn.).

Acrolophus angustipenellus Dyar, 1900, Can. Ent., vol. 32, no. 10, pp. 308–309 (syn.). (Misspelling.)

Acrolophus (*Anaphora*) *plumifrontella* Busck, 1903, Proc. Ent. Soc. Washington, vol. 5, p. 186.

Acrolophus (*Anaphora*) *bombycina* Busck, 1903, Proc. Ent. Soc. Washington, vol. 5, p. 186 (syn.).

Clemens' original description of *plumifrontellus*, which probably did not actually appear in print until sometime in 1860, is quoted below:

Anaphora plumifrontella—Labial palpi reddish brown. Thorax dull brown tinged with reddish. Fore wing rubescent and maroon brown intermixed, the former hue prevailing along the fold, at the base along costa and disc, dusted with dark brown; with a dusky or dark brownish spot on the end of the disc, one about the middle of the fold and another near the base. In some specimens these spots are quite indistinct. Hind wings dusky brown. Exp. al. 17 lines [about 36 mm.]. Female not known.

Clemens mentioned elsewhere in his paper that the labial palpi in the ♂ were "greatly developed, ascending and thrown back on the dorsum of the thorax, which they equal in length." Clemens' figure for *plumifrontellus*, an engraving of the head of the ♂, was subsequently published by Stainton (1872, p. 60, fig. 3) in his collected edition of the late Dr. Clemens' writings on North American Tineina. In the same paper describing *plumifrontellus*, but preceding his erection of the genus, *Anaphora*, Clemens stated:

Plumifrontella is found here (Philadelphia) in June and July, when it may be taken at light. I am unacquainted with the embryonic history of the species described, and have never met with the female *Plumifrontella*. The genus, I think, belongs to the group Exapatidae, and as the females in some of the genera are apterous, that of *Plumifrontella* may be unsupplied with wings. The antennae should be examined very carefully, otherwise their peculiar structure will be overlooked and mistaken for simple, filiform organs.

Walsingham (1887, p. 149) made the following comments on Clemens' original description of *plumifrontellus*:

To this description we may add that the antennae are compressed, not strictly serrated throughout, but only slightly so towards the tip; lateral claspers spoon-shaped, rather abruptly dilated and bent, with a pair of supplementary claspers above them, nearly as long as themselves; uncus double, the points parallel and divided.

At the same time, Walsingham (1887, pl. 7, figs. 5–5e) furnished a number of illustrations for this species. These consisted of: figure 5 adult ♂, dorsal aspect (in color); figure 5a head of ♂, lateral aspect; figure 5b head of ♀, lateral aspect; figure 5c ♂ genitalia-uncus and cucullus of harpe, with "supplementary clasper," lateral aspect; figure 5d ♀ genitalia, ventral (?) aspect; and, figure 5e neuration of forewing.

Beutenmüller (1889) described the ♀ of *plumifrontellus* as follows:

The undescribed ♀ of this species differs from the ♂ only in having long porrected labial palpi, and the markings of the primaries much suffused with the ground color. Expanse, 19 mm. Length of palpi, 5 mm.

One example. Coll. Beutenmüller. Taken at Parkville, L.I., N.Y., July, 1888. Another specimen, much larger than the one I possess, is in the collection of Mrs. A. T. Slosson, taken in the White Mountains, N.H.

MALE GENITALIA.—Vinculum typical, as in other species, but rather heavily sclerotized.

Tegumen glabrous; lateral arm rather elongate and slender, strongly narrowing to point of articulation with vinculum, dorsal margin rather weakly sclerotized and sinuate, ventral margin well sclerotized and sublinear; dorsal area of medium width, not separated along meson.

Harpe divided, with prominent costal process. Lateral aspect: approximate apical two-fifths directed somewhat ventrad and considerably narrower than basal three-fifths, basal three-fifths sublinear; costa and sacculus indistinctly fused, comprising approximate basal half of harpe, glabrous except for punctate and setose ventrocaudal margin of sacculus, broadest in apical fifth, basal four-fifths with dorsal and ventral margins sublinear and gradually converging basad to broadly rounded basal extremity, dorsocaudal portion of costa considerably expanded and giving rise to large costal process; costal process arising from dorsobasal angle near base of cucullus, approximately four-fifths as long as cucullus and two-fifths as long as entire harpe, sublinear, directed considerably ventrad, major portion closely subparallel with dorsal margin of cucullus, small apical portion overlapping ectal surface of cucullus dorsad, dorsal and ventral margins sinuate and subparallel, approximate dorsal third to half very heavily sclerotized and becoming minutely spinose toward apex, ventral half to two-thirds weakly sclerotized and minutely punctate, apical one-sixth to one-fourth very densely and minutely spinose, apex weakly expanded and evenly rounded; cucullus partially set off from costa and sacculus by areas of reduced sclerotization, comprising approximate apical half of harpe, broadest in basal fifth, markedly constricted ventrad immediately distad of basal fifth, apical three-fifths irregularly expanding toward apex, basal third glabrous, apical two-thirds becoming increasingly punctate and setose ectad and entad toward apex, margins sinuate, dorsal margin very heavily sclerotized in basal three-fifths, ventral margin heavily sclerotized in basal two-fifths and with or without apical half minutely dentate, apex rounded.

Transtilla with arm elongate and slender, approximately three-tenths as long as harpe, well sclerotized, glabrous, basal two-thirds subparallel with dorsal margin of costa, apical third converging with and underlapping costa, terminating acutely somewhat distad of basal extremity of harpe.

Uncus bifid. Dorsal aspect: base rather large, subtriangular, rather indistinctly fused with tegumen, heavily punctate and setose; lateral margins very heavily sclerotized, sublinear, gradually converging distad; angle of bifurcation rather narrow, rounded; furcae of medium length and width, tubular, well sclerotized, slightly diverging

and gradually curving ventrad toward apices, basal portions sparsely punctate and setose, apical portions glabrous, gradually narrowing distad to acute apices.

Gnathos typically paired, curving ventrocaudad, well sclerotized; arms rather short and broad, finely and densely pitted entad, diverging distad, apices broadly and unevenly rounded.

Anellus membranous, unarmed, juxta absent.

Aedeagus of medium length and width, approximately two-thirds as long as harpe, sublinear in dorsal and ventral aspects, basal and apical portions directed slightly ventrad in lateral aspect, cylindrical, asymmetrical, glabrous, base unexpanded and opening dorsad, approximate apical half to two-thirds opening broadly dorsad and consisting of well sclerotized ventral wall expanding slightly toward apex, apex irregularly rounded and emarginate.

Vesica large, membranous, consisting of several infolded layers, armed dorsad with approximately 50 minute cornuti; cornuti more or less alined in dense row in central portion and also scattered through apical portion of vesica, mostly subtriangular and acute, pointing in all directions, variously sized, some short and triangular, others longer, several asymmetrically bifid.

TYPE.—Type ♂ in the Academy of Natural Sciences of Philadelphia.

TYPE LOCALITY.—Presumably Philadelphia, Pa.

DISTRIBUTION.—Central and eastern United States. Nebraska and Texas eastward to New Hampshire and Florida.

SPECIMENS EXAMINED.—317, from 80 localities, as follows (the large number of specimens available for study has made it advisable to reduce the distributional data for this common species largely to the localities and months of occurrence):

ARIZONA: One ♂ from the American Museum of Natural History, labeled "Ariz., Chas. Palm, Don. 1911"; this record is very questionable. ARKANSAS: Camden (June). CONNECTICUT: East River (July); Hamden (July); High Ridge (July); New Haven (June). FLORIDA: Clewiston (April); Florida City (June, Sept.); Gainesville (June and July, traplight); La Belle (April); Lake Placid (July, Archbold Biological Station); Orlando (April, June, Aug.); Port Sewall (April); Punta Gorda (May); Sanford (April, June); Stemper (June); Tampa (April and May, at light); Winter Park (May, June, July). GEORGIA: Screven Co. (July, 1 ♀ with mite on abdomen); Spring Creek, Decatur Co. (June, July); Tallapoosa (July). ILLINOIS: Dubois (July, at light); Elizabethtown (June, at light). INDIANA: Hessville (June, July); Scottsburg (June); Tremont (June, July). KANSAS: Caldwell (June, at light); Douglas Co. (June); Manhattan (June); Medora (June); Montgomery Co. (June). MARYLAND: Baltimore (July). MISSISSIPPI: A. & M. College, State College (June, July). MISSOURI: Glencoe (June); Kirkwood (May, June, Sept.); Mineola (July); St. Louis (June). NEBRASKA: Lincoln (June, July). NEW HAMPSHIRE: Franconia (no date). NEW JERSEY: Browns Mills (May); Irvington (July); Lakewood (May); New Brunswick (July); Ramsey (June, Sept.); Weymouth (June). NEW YORK: Millwood (June), Long Island: Brooklyn (no date); Greenport (Aug.); Mattituck (July);

Orient (June, July, Aug.); Patchogue (July); Richmond Hill (July); Roslyn (July). NORTH CAROLINA: Black Mountains (no date); Brevard (June, July, Aug.); Connestee Falls, near Brevard (July); Hickory (July); Maxton (May, June); Pineola (July); Pisgah ("Base of Mt. Pisgah," July); Raleigh (June, July, Oct.). OHIO: Granville (June, July); West Lafayette (July, at light). OKLAHOMA: Broken Bow (June); Strang (June); Wyandotte (June). PENNSYLVANIA: Cedar Top (June); "Clarksval." (July); Finleyville (June, July); Harrisburg (July); Lancaster (July); New Brighton (July); Oak Station, Allegheny Co. (June); Phoenixville (no date); Pittsburgh (July, Aug., Oct.); Washington County (July). SOUTH CAROLINA: Myrtle Beach (June, July). TENNESSEE: Camp Forrest (June); Monteagle (June, July). TEXAS: Galveston (May); also, one ♀, without an abdomen, from the American Museum of Natural History, labeled "Tex., Chas. Palm, Don. 1911." WEST VIRGINIA: Williamson (July).

REMARKS.—One of the first three acrolophids described from the United States, *plumifrontellus* ranks second only to *popeanellus* in extent of distribution and abundance of individuals. These three factors explain its relatively large synonymy. The material representing *plumifrontellus* was received on loan from numerous sources. Good series containing both sexes are to be found in the collections of the American Museum of Natural History, the California Academy of Sciences, and Cornell University.

A. plumifrontellus is related to those acrolophids having elongate labial palpi, setose eyes, laminate antennae, bifid uncus, and paired gnathos. It may be easily distinguished by its harpes, each of which bears a large and prominent costal process overlapping the cucullus. This process, clearly observable in dried specimens, causes the cucullus of the harpe to appear as a double or divided structure. The genital characters of *plumifrontellus* are consistent throughout my large series and they are quite distinct from those of all the other acrolophids treated here. It is one of the largest and most robust species of *Acrolophus* in America north of Mexico.

I have not examined the type specimen of this species. Busck (1903), in his report on Clemens' types of Tineina deposited in the collection of the Academy of Natural Sciences in Philadelphia, stated:

> *Anaphora plumifrontella* Clemens. One somewhat rubbed type, Clemens' No. 10; alar exp., 33 mm. This type verifies the present conception of the species, as defined by Walsingham, with *bombycina* Zeller as synonym. It belongs to the genus *Acrolophus* Poey. A large series, collected at light by the writer at Washington, D.C., and compared with Clemens' type, is in the U.S. National Museum.

Darlington (in a letter, 1946) has reported that this type is still at Philadelphia: "*plumifrontella* Clem. Type, ♂, much rubbed and not distinguishable by maculation; right wings expanded, only. Abdomen gone." The combined information I have been able to gather for *plumifrontellus* leaves no doubt as to the proper identity and correct concept of this species. I have carefully checked the U.S. National Museum's series of specimens determined as *plumifrontellus* and found

them to agree with my previous concept of this moth. In addition, at the Museum there are several slide preparations of ♂ genitalia, labeled "*plumifrontellus* Clem.," agreeing with my figures representing this species.

Walsingham (1897) reported *plumifrontellus* from the West Indies (Cuba and Puerto Rico). Barnes and Lindsey (1921) have published a photograph of a preparation of the entire ♂ genitalia of this species in ventral aspect.

Zeller, in describing *Anaphora bombycina* as a new species in 1873, concluded his discussion of Clemens' genus *Anaphora* by saying of his own series of specimens: "Whether I have Clemens' species among my own before me, I cannot decide with certainty from his descriptions; therefore I am giving the latter under separate names." He described *scardina* and *bombycina* at considerable length, and was aware of the similarity between his *bombycina* and Clemens' *plumifrontella*, for in his remarks following his description of the former he stated: "The maroon-brown, on which Clemens places considerable stress in the case of his *plumifrontella*, I fail to find throughout my specimens." Zeller listed the sources of his material as follows: "Native land of the ♀ (according to Lederer), Buenos Ayres; the two ♂♂, which I obtained through Dr. Packard, presumably come from Massachusetts." Thus, there is a strong suggestion that the series he considered as *bombycina* contained at least two different species. Walsingham (1887), in placing *bombycina* as a synonym of *plumifrontellus*, stated:

> In Zeller's series are four specimens; two from Massachusetts, sent by Mr. Packard and labeled "*bombycina*, Z."; a third from New York, with a label in Mr. Grote's handwriting, "*plumifrontella*, Clem."; the fourth is labeled "*bombycina*" in Zeller's writing, and is a female, evidently of a different species, from Buenos Ayres, received from Lederer. Professor Zeller (Verh. z.-b. Ges. Wien, 1873) mentions his doubts about this South American female, but remarks that his scruples were removed by the fact that "the wing-veins correspond exactly" with those of the male from Massachusetts. We may thus safely conclude that *bombycina* and *plumifrontella* are one and the same species.

Since 1887, *bombycina* has consistently appeared in the literature as a synonym of *plumifrontellus*. Despite the fact that Zeller apparently had a mixed series representing *bombycina*, there is no reason to doubt that his North American ♂♂ were *plumifrontellus*. Photographs furnished by Mr. Tams, labeled "type ♂, *bombycina* Zell.," show, through a dorsal view of the adult and a ventral view of the entire ♂ genitalia, that it is unmistakably a typical specimen of *plumifrontellus*. Thus, *bombycina* should be considered an old synonym of *plumifrontellus* and Walsingham should be given credit for sinking it. The name is spelled *bombycinus* to agree grammatically with its present genus, *Acrolophus*.

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Walsingham described the ♀ of *A. cervinus* as a new species in 1887. His brief description was annotated as follows:

> Exp. al. 34 mm. Two females collected by Belfrage in Texas on the 16th and 18th May (about 1868) respectively. I have not seen the male of this species, but, although probably closely allied to *plumifrontellus*, the narrow fore wings with straight costa and almost straight oblique apical margin show it to be distinct from that species.

There is nothing in Walsingham's description of and comment on *cervinus* to prove that it could not be *plumifrontellus*. In addition, his single illustration of the head of the ♀ in lateral aspect appears about the same as his figure of the ♀ head for *plumifrontellus*.

In 1900, Dyar properly suspected *cervinus* to be synonymous with *plumifrontellus* when he said of the former: "The genitalia of this form do not differ perceptibly from those of *plumifrontellus*, Clem. The moths are smaller, paler and less strongly marked, somewhat narrower winged; but I doubt the specific distinctness of the form." However, Dyar continued to list *cervinus* as a distinct species in his check list of 1903.

The type ♀ is at the British Museum. A photograph from Tams labeled "*cervinus* Wals., type ♀" shows the adult in dorsal aspect. It is evident that the type specimen is simply a pale or faded ♀ of *plumifrontellus*. Thus, *cervinus* Walsingham should be considered an old synonym of *plumifrontellus* (Clemens) with Dyar and Forbes receiving most of the credit for properly placing it.

In 1887, Beutenmüller briefly described his "*Acrolophus plumifrontellus*, Clem., var. *angustipennella*, n. var." as follows: "This variety differs from the type form in having the wings much narrower, and the markings almost absent. It is also much smaller. Expanse of wings 25 mm. 6 ♂, Georgia and Fla."

I have received numerous specimens from Georgia, Florida, and elsewhere answering to Beutenmüller's brief description of *angustipennella* quoted above. Examination of the genitalia of these moths has clearly shown them all to be simply minor geographical variations of *plumifrontellus*.

The type ♂ in the U.S. National Museum is labeled "type no. 402, Florida, Beutenmueller Collection." Its genitalia had been removed and mounted on a slide by August Busck on Aug. 9, 1920. These confirmed the identity of *angustipennellus* with *plumifrontellus*. Therefore, *angustipennellus* Beutenmüller should be considered an old synonym of *plumifrontellus* (Clemens) with Dyar receiving most of the credit for its proper placement.

10. *Acrolophus mortipennellus* (Grote)

FIGURES 59–64

Anaphora mortipennella Grote, 1872, Can. Ent., vol. 4, no. 7, p. 137, July.—Chambers, 1878, Bull. U.S. Geol. & Geogr. Surv. Terr., vol. 4, no. 1, p. 129.—Walsingham, 1882, Trans. Amer. Ent. Soc., vol. 10, p. 167.

Acrolophus mortipennella Grote, 1886, Can. Ent., vol. 18, no. 10, p. 199.

Acrolophus mortipennellus Walsingham, 1887, Trans. Ent. Soc. London, p. 150.—Smith, 1891, List Lep. Bor. Amer., p. 94, no. 5050.—Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8169.—Forbes, 1923, Lep. New York, pp. 120, 122, fig. 98.—Comstock, 1924, Intro. to Ent., p. 611.—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 103, no. 9555.

Cænogenes mortipennella Forbes, 1890, Sixteenth Rep. Ill., p. 101, pl. 6, fig. 1.

Acrolophus quadripunctellus Smith, 1891, List Lep. Bor. Amer., p. 95, no. 5057 (first appearance in print of Beutenmüller's manuscript name).—Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8169 (syn.).—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 103, no. 9555 (syn.).

Hypoclopus mortipennellus Dyar, 1900, Can. Ent., vol. 32, no. 10, pp. 307–308.—Forbes, 1905, Twenty-Third Rep. Ill., pp. 44, 95–98, fig. 78.

Hypocolpus mortipennellus Dyar, 1903, List North Amer. Lep., p. 578, no. 6583.

Hypoclopus quadripunctellus Dyar, 1900, Can. Ent., vol. 32, no. 10, p. 307, Oct. (syn.) (Beutenmüller's manuscript name validated by Dyar).

Hypocolpus quadripunctellus Dyar, 1903, List North Amer. Lep., p. 578, no. 6583 (syn.).

Acrolophus carphologa Meyrick, 1919, Exotic Microlep., vol. 2, no. 9, p. 280, Nov.—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 103, no. 9573. (New synonymy.)

Cænogenes zeella Fernald, MS. (chironym). (New synonymy.)

Grote's original description follows:

Anaphora mortipennella— ♂.—Labial palpi reflexed, thrown back over and as long as the dorsum of thorax, but not closely applied, thickly scaled but less so than in allied species, fuscous outwardly along the sides, dead whitish on the inside. Head and thorax above dead or dirty whitish. Primaries pale, dirty whitish, with heavily sprinkled black scales on costal region at base, fading outwardly. A black scale patch at extremity of discal cell, and a larger one on submedian fold, below median vein, at about the middle of the wing; parallel with this at base, a few black scales. There is a faint sprinkling of black scales over the median nervules, and about internal angle are two or three better marked black points on the margin. Four costal black marks before the apex, the first of these above discal spot; other costal marks towards the base of the wing. Fringes fuscous, faintly lined. Secondaries fuscous, much darker than, and strangely contrasting with, the pallid primaries. Beneath both wings fuscous with ochrey stains. The basal joint of labial palpi is prominently dark fuscous or blackish outwardly. Expanse 25 mm. Central Alabama. June.

Smaller than *A. plumifrontella*, and easily recognized by its pallid discolorous fore wings, which are also a little more determinate at apices and internal angle than usual.

MALE GENITALIA.—Vinculum typical, as in other species.

Tegumen glabrous; lateral arm of medium length, margins well sclerotized and sinuate, caudal portion markedly broad, remaining

portion gradually narrowing cephalad to become very narrow at point of articulation with vinculum; dorsal area rather broad and with mesal portion consisting largely of prominent, very heavily sclerotized, pentagonal or subcircular plate produced mesocaudad between and articulating laterad with lateral margins of base of uncus.

Harpe simple. Lateral aspect: apical half very slender, approximate apical quarter curving strongly ventrad; costa and sacculus fused, comprising approximate basal three-sevenths of harpe, broadest in apical half, basal half narrowing basad to subacute basal extremity; glabrous except for punctate and setose, subdigitate, ventrocaudal margin of sacculus; cucullus partially set off from costa and sacculus by ventral area of reduced sclerotization, comprising apical four-sevenths of harpe, with approximate apical three-fourths very slender; basal half curving considerably dorsad, rather sparsely punctate and setose ectad and entad; apical half curving evenly and strongly ventrad, becoming more heavily punctate and setose ectad and entad toward apex; apex rather narrow, evenly rounded.

Transtilla with arm rather short, approximately one-fifth as long as harpe, moderately sclerotized, glabrous, basal two-thirds slender and subparallel with dorsal margin of costa, apical third expanded and overlapping costa, apex rounded, terminating at or near basal extremity of harpe.

Uncus prominently bifid, large, very distinctive. Dorsal aspect: base large, nearly rectangular, glabrous, mesobasal portion weakly sclerotized and fusing with dorsomesal plate of tegumen, mesocaudal portion very weakly sclerotized to membranous; lateral margins very heavily sclerotized, subparallel, distinctly set off from tegumen laterad by areas of greatly reduced sclerotization, basal portions considerably expanded laterad; angle of bifurcation very broad; furcae with bases broadly separated and produced mesoventrad into narrowly separated pair of prominent, heavily sclerotized and darkened, sparsely punctate and setose, semicircular plates with dentate margins; furcae large, heavily sclerotized, very sparsely setose, curving or directed very strongly ventrad; basal portions tubular, convergent, commonly overlapping distad; apical portions flattened dorsoventrad, markedly divergent; apices appearing acute or subacute in dorsal, ventral, and lateral aspects; apices expanded, broadly and evenly rounded in caudal aspect.

Gnathos paired, moderately sclerotized, directed ventrocaudad; arms large, elongate, flattened, overlapping distad, apical portions finely pitted, apices broadly and evenly rounded.

Anellus membranous, unarmed, juxta absent.

Aedeagus rather short, approximately four-sevenths as long as harpe, stout, somewhat flattened dorsoventrad, tubular, asymmetri-

cal, weakly sinuate in dorsal and ventral aspects, approximate apical half curving somewhat ventrad in lateral aspect, base very weakly and irregularly expanded ventrad, central portion bearing series of dorsodextral ridges, apical portion gradually narrowing and opening irregularly ventrad and distad.

Vesica membranous, consisting of compactly infolded layers, armed with two large cornuti: cornuti heavily sclerotized and darkened, asymmetrical, directed distad, each with basal half irregularly expanded, apices acute; basal cornutus largest, approximately one-third as long as aedeagus; apical cornutus about half as large as basal cornutus, situated at apex of vesica.

TYPE.—Type ♂ in the Academy of Natural Sciences of Philadelphia.

TYPE LOCALITY.—"Central Alabama."

DISTRIBUTION.—Central and eastern United States. Iowa, Kansas, and Texas eastward to Pennsylvania, Virginia, and South Carolina.

SPECIMENS EXAMINED.—88, from 30 localities (1 ♀ without data):

ALABAMA: Flatwood, ♂ (June 10, 1917); La Place, near Tuskegee, ♂ (June 9, 1917). ILLINOIS: Champaign, 5 ♂♂ (June 8–28, 1946, at light, J. L. C. Rapp and W. F. Rapp); "Northern Illinois," ♂ (June 1906, M. E. Murtfeldt); Palos Park, ♂ (July 6, 1912, A. Kwiat), ♂ (July 4, 1940, A. K. Wyatt); Putnam Co., 11 ♂♂, 2 ♀♀ (May 29 to July 10, 1933 to 1943, M. O. Glenn); Urbana, ♂ (June 15, 1887, at light, Hart), ♂ (June 12, 1912, at light), 6 ♂♂, ♀ (June 21–26, 1943, at light, F. F. Hasbrouck, P. C. Lurie, F. A. Orr). INDIANA: Hessville, ♂ (June 10, 1911, A. Kwiat); Tremont, ♂ (June 20, 1931, A. K. Wyatt). IOWA: Denison, ♀ (June 25, 1949); Sioux City, ♀ (June 16, 1925, at light, C. N. Ainslie). KANSAS: Clark Co., 3 ♂♂ (May and June, elevation 1962 feet, F. H. Snow); Douglas Co., ♀ (June 10, 1925, mite on abdomen, R. H. Beamer); Lawrence, ♂ (May, twilight, E. S. Tucker); Manhattan, ♂, 4 ♀♀ (May 29 to June 2, 1933, gasoline light, H. L. Nonamaker), ♀ (June 14, 1939, H. D. O. Miller); Onaga, ♂ (no date, F. F. Crevecoeur). MISSOURI: Glencoe, ♂ ("Rockwoods Res.," June 4, 1942, H. I. O'Byrne); Kirkwood, 9 ♂♂, ♀ (June and July, 1890 to 1912, M. E. Murtfeldt); St. Louis, ♀ (July 9, 1904, H. McElhose); Willard, ♂ (June 9, A. E. Brower). OHIO: Granville, 7 ♂♂ (July 3–22, 1928 and 1929, A. W. Lindsey). PENNSYLVANIA: Finleyville, 4 ♂♂, ♀ (June 9 to July 1, Engel collection); Pittsburgh, ♂ (June 10, Ehrman collection). SOUTH CAROLINA: Anderson, ♂ (June 5, 1917). TENNESSEE: Locality unknown, 2 ♂♂ ("Tenn.," Cornell University collection). TEXAS: Brownsville, ♂ (June 5, 1932, five mites on abdomen, J. O. Martin); Burnet Co., ♂ (date and collector unknown); Uvalde, ♂ (May 16, 1928); locality unknown, 6 ♂♂ ("Texas," Andreas Bolter collection). VIRGINIA: Dinwiddie, ♂ (June 1, 1917).

REMARKS.—*A. mortipennellus*, an old, widely distributed, and locally common species, has a relatively large synonymy with material received on loan from thirteen sources. Among the larger series are those in the collections of the author (11 ♂♂, 1 ♀), Cornell University (17 ♂♂, 4 ♀♀), the American Museum of Natural History (2 ♂♂, 5 ♀♀), and Mr. Murray O. Glenn of Magnolia, Ill. (11 ♂♂, 2 ♀♀).

A. mortipennellus is related to those acrolophids having elongate labial palpi, setose eyes, laminate antennae, bifid uncus, and paired gnathos. It may be easily distinguished from all other members of the genus by its uncus, the furcae of which have their bases very broadly separated and developed ventrad into a pair of prominent plates. The apical portions of these furcae, easily observable in undissected specimens, are also very distinctive. The genital characters of *mortipennellus* are consistent throughout my fairly large series and they serve well in separating this species from all others treated here. The color pattern and general habitus of this rather frail moth also distinguish it from its congeners.

Darlington in a letter (1946) reports on the type specimen of this species at the Academy of Natural Sciences: "*mortipennella* Grote. Type ♂, much rubbed but in recognizable condition; all wings and abdomen present." It has also been inferred to be at Cambridge, Massachusetts (see following discussion on status of *A. quadripunctellus*). There seems to be little doubt as to the identity of Grote's *mortipennellus*. The original description agrees very closely with my series of specimens representing this species. In addition, most workers agree upon the concept of *mortipennellus*, since practically all of the many specimens I have seen determined by others as this species have proved to be both alike and representative of this moth. At the U.S. National Museum there are several slide preparations, labeled "*mortipennellus* Grote," containing ♂ genitalia. These also agree with my concept of the species in question.

Beutenmüller's manuscript name, *A. quadripunctellus*, first appeared in print in 1891 in Smith's checklist, where it was listed as a valid species. Dyar (1900) referred to the name in Smith's list as "*quadripunctellus*, Beut. (*ined.*)," indicating it was *ineditus*, i.e., "not made known, unpublished." In addition, Dyar validated *quadripunctellus* by properly placing it as a synonym of the older species, *mortipennellus* (Grote), which in turn he transferred to the genus, *Hypoclopus*. Thus, the synonym emerged as *Hypoclopus quadripunctellus* Dyar. At the end of his discussion of *mortipennellus*, Dyar listed the following distributional data: "Texas (coll. Beutenmüller, type of *quadripunctellus*); Texas, Sept. 20 (Belfrage); Central Missouri, Aug. 12 and 15 (coll. C. V. Riley); Kansas (Crevecoeur); Georgia (coll. Beutenmüller); Texas (coll. Beutenmüller, labeled 'compared with type of *A. mortipenella* at Cambridge, Mass.')." Since there was no published description for *quadripunctellus*, it is apparent that Dyar had Beutenmüller's manuscript type specimen (chirotype) available for study.

In 1903, the combination, *quadripunctellus* Dyar, appeared as a synonym of *H. mortipennellus* in Dyar's checklist. Since that date, *quadripunctellus* has consistently appeared in the literature as a synonym of *mortipennellus*.

There is no indication that Beutenmüller actually did publish a description of *quadripunctellus*. He invariably described his new species in this group under *Acrolophus*, and the combination, *A. quadripunctellus* Beutenmüller, is not listed in the Zoological Record between the years 1891, when it first appeared in Smith's checklist, and 1886, when Beutenmüller's name first appeared as an author in the Zoological Record.

The type ♂ is in the U.S. National Museum main collection and is labeled "type no. 406, Texas, Beutenmueller Collection." The type specimen now lacks the abdomen and hindwings, but its characteristic labial palpi and coloration of the forewings unquestionably identify it as an example of *mortipennellus*. Thus, *quadripunctellus* (Dyar) should be considered an old synonym of *mortipennellus* (Grote) with Dyar receiving the credit for its placement.

Meyrick described *A. carphologa* as a new species in 1919 on the basis of a single ♂ specimen from Iowa. Since that time, *carphologa* has appeared in the literature as a distinct species.

The type ♂ is at the British Museum (Natural History). Two photographs labeled "*carphologa* Meyr." from Tams very clearly reveal, through a dorsal view of the moth and a lateroventral view of its entire genital capsule, that *carphologa* is a typical example of *mortipennellus*. In addition, Meyrick's description of *carphologa* can be quite easily recognized as a description of *mortipennellus*.

Thus, *carphologus* Meyrick should be considered a new synonym of *mortipennellus* (Grote), the change in spelling bringing grammatical agreement between species and genus.

Two photographs from Tams labeled "*Caenogenes zeella* Fernald (MS), Illinois" represent an unpublished species which, at the present time, is based only upon Fernald's manuscript species name (chironym) and the type ♂ specimen (chirotype) it designates. The photographs of Fernald's *zeella*, showing a dorsal view of the pinned moth and a lateroventral view of its genitalia, clearly reveal that it is a typical example of *mortipennellus*, a species occurring frequently in Illinois. Therefore, I propose to validate Fernald's manuscript species, *zeella*, by placing it as a new synonym of *A. mortipennellus* (Grote). The name is spelled *zeellus* to agree grammatically with the present generic name.

11. *Acrolophus popeanellus* (Clemens)

FIGURES 5–24

Anaphora popeanella Clemens, 1859, Proc. Acad. Nat. Sci. Philadelphia, p. 261, Sept.; 1872, Tineina of North Amer., pp. vii, 57, 60, fig. 4.—Grote, 1872, Can. Ent., vol. 4, no. 7, p. 137.—Grote, 1872, Can. Ent., vol. 4, no. 8, p. 143.—Zeller, 1873, Verh. zool.-bot. Ges. Wien, vol. 23, pp. 215–216.—Chambers, 1878, Bull. U.S. Geol. & Geogr. Surv. Terr., vol. 4, no. 1, p. 129.—Walsingham, 1887, Trans. Ent. Soc. London, pp. 138, 155–156, 161–162, pl. 8, figs. 11, 11a, 11b, 11c.—Riley, 1890, Insect Life, vol. 3, no. 1, pp. 27–28.—Smith, 1891, List Lep. Bor. Amer., p. 95, no. 5061.—Walsingham, 1891, Proc. Zool. Soc. London, pp. 515, 545.—Walsingham, 1897, Proc. Zool. Soc. London, p. 172.—Dyar, 1900, Can. Ent., vol. 32, no. 10, p. 309.—Dyar, 1900, Can. Ent., vol. 32, no. 11, p. 327.—Busck, 1903, Proc. Ent. Soc. Washington, vol. 5, p. 187.—Dyar, 1903, List North Amer. Lep., p. 579, no. 6594.—Holland, 1903, Moth Book, p. 443 (fig. cited is not *popeanellus*).—Forbes, 1905, Twenty-Third Rep. Ill., pp. 44, 95–98.—Walsingham, 1915, Biol. Centr.-Amer., pt. 12, vol. 4, pp. 376, 396.

Anaphora agrotipennella Grote, 1872, Can. Ent., vol. 4, no. 7, p. 137 (♂), July.—Grote, 1872, Can. Ent., vol. 4, no. 8, pp. 142–143 (♀), Aug.—Murtfeldt, 1876, Can. Ent., vol. 8, no. 10, pp. 185–186.—Chambers, 1878, Bull. U.S. Geol. & Geogr. Surv. Terr., vol. 4, no. 1, p. 129.—Walsingham, 1882, Trans. Amer. Ent. Soc., vol. 10, p. 167.—Walsingham, 1887, Trans. Ent. Soc. London, pp. 138, 161–162 (syn.).—Forbes, 1890, Sixteenth Rep. Ill., p. 98.—Smith, 1891, List Lep. Bor. Amer., p. 95, no. 5061 (syn.).—Walsingham, 1897, Proc. Zool. Soc. London, p. 172 (syn.).—Busck, 1903, Proc. Ent. Soc. Washington, vol. 5, p. 187 (syn.).—Dyar, 1903, List North Amer. Lep., p. 579, no. 6594 (syn.).—Holland, 1903, Moth Book, p. 443 (syn.).

Anaphora scardina Zeller, 1873, Verh. zool.-bot. Ges. Wien, vol. 23, p. 215, May.—Chambers, 1878, Bull. U.S. Geol. & Geogr. Surv. Terr., vol. 4, no. 1, p. 129.—Walsingham, 1887, Trans. Ent. Soc. London, pp. 161–162 (syn.).—Smith, 1891, List Lep. Bor. Amer., p. 95, no. 5061 (syn.).—Walsingham, 1897, Proc. Zool. Soc. London, p. 172 (syn.).—Busck, 1903, Proc. Ent. Soc. Washington, vol. 5, p. 187 (syn.).—Dyar, 1903, List North Amer. Lep., p. 579, no. 6594 (syn.).—Holland, 1903, Moth Book, p. 443 (syn.).

Acrolophus agrotipennella Grote, 1886, Can. Ent., vol. 18, no. 10, p. 199.—Forbes, 1923, Lep. New York, p. 121 (syn.).

Acrolophus agrotipennellus Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8185.—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 103, no. 9575.

Anaphora morrisoni Walsingham, 1887, Trans. Ent. Soc. London, p. 157, pl. 8, fig. 12, June.—Smith, 1891, List Lep. Bor. Amer., p. 95, no. 5059.—Dyar, 1900, Can. Ent., vol. 32, no. 11, p. 327; 1903, List North Amer. Lep., p. 578, no. 6593. (New synonymy.)

Acrolophus confusellus Smith, 1891, List Lep. Bor. Amer., p. 94, no. 5056 (first appearance in print of Beutenmüller's manuscript name).—Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8182.—Forbes, 1923, Lep. New York, pp. 120–121 (syn.?).—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 103, no. 9568.

Anaphora confusellus Dyar, 1900, Can. Ent., vol. 32, no. 10, p. 309, Oct. (Beutenmüller's manuscript name validated by Dyar); 1903, List North Amer. Lep., p. 578, no. 6592. (New synonymy.)

Acrolophus morrisoni Barnes & McDunnough, 1917, Check List Lep. Bor. Amer.,

p. 191, no. 8180.—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 103, no. 9566.

Acrolophus popeanellus Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8184.—Forbes, 1923, Lep. New York, pp. 25, 120–122, figs. 19, 95.—Comstock, 1924, Intro. to Ent., p. 611.—Eyer, 1924, Ann. Ent. Soc. Amer., vol. 17, no. 3, p. 315, pl. 35, fig. 2 (mislabeled).—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 103, no. 9570.

Acrolophus popeanella Meyrick, 1919, Exotic Microlep., vol. 2, no. 9, p. 279.

Acrolophus scardina Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8184 (syn.).—Forbes, 1923, Lep. New York, p. 121 (syn.).—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 103, no. 9570 (syn.).

Clemens' original description of *popeanellus*, which probably did not actually appear in print until sometime in 1860, is as follows:

Anaphora Popeanella—Labial palpi dark brownish, whitish? at the tip in the ♀. Thorax dull brownish in the ♂, with the tegulae tipped behind with gray; whitish? tinged with brown in the ♀. Fore wings brownish luteous or dull reddish brown, with luteous or yellow along the fold and inner margin, a spot on the disc and one on the middle of the nervules of the same hue, with a dark brown spot between them; a dark brown spot on the fold beneath median vein, most frequently semicircular, with a short, dark brown streak at the base on the submedian vein and another parallel to it beneath the median. The anterior margin striated from the costa with dark brown, with a subterminal row of dark brown spots *above the branches of the median vein*, and the ends of the nervules dotted with the same hue; cilia pale yellowish brown. Hind wings brownish yellow, cilia the same. Exp. al. 12 to 18 lines [about 25.5 to 38 mm.]. Male and female alike. From Smithsonian Institution. Capt. Pope's collection in Texas.

Clemens mentioned elsewhere in his paper that the labial palpi in the ♂ were "greatly developed, ascending and thrown back on the dorsum of the thorax, which they equal in length." He also mentioned that the antennae of the ♂ were "distinctly serrated beneath." Clemens' figure for *popeanellus*, an engraving of the head of the ♀, was subsequently published by Stainton (1872, p. 60, fig. 4) in his collected edition of the late Dr. Clemens' writings on North American Tineina.

Walsingham (1887, p. 162) made the following comments on Clemens' original description of *popeanellus:*

Now, so far as the antennae and palpi are concerned, Clemens' observation "male and female alike" is certainly misleading. The antennae of the male are stout and deeply serrated, "with the ends of the articles finely ciliated," as described by him. Those of the female are simple. The lateral claspers are elongate, spoon-shaped, scarcely dilated, and evenly rounded. The uncus double, angulated above, and bent over at right angles, with a conspicuous thickening at the angle.

At the same time, Walsingham (1887, pl. 8, figs. 11–11c) furnished a number of illustrations for this species. These consisted of: (fig.11) adult ♂, dorsal aspect (in color); (fig. 11a) head of ♂, lateral aspect; (fig. 11b) head of ♀, lateral aspect; and, (fig. 11c) ♂ genitalia — uncus and cucullus of harpe, dorsal and lateral aspects.

MALE GENITALIA.—Vinculum typical. Ventral aspect: in form of moderately sclerotized, U-shaped pouch receiving and supporting bases of harpes. Lateral aspect: narrowing dorsocaudad to point of articulation with lateral arm of tegumen.

Tegumen with lateral arm quite broad, gradually narrowing cephalad to point of articulation with vinculum, approximate ventral half punctate, dorsal half glabrous, ventral margin heavily sclerotized and sinuate, dorsal margin moderately sclerotized and sublinear; dorsal area broad, glabrous, rather weakly sclerotized but not emarginate mesad.

Harpe simple, slightly variable. Lateral aspect: width medium, sublinear or with apical half curving somewhat ventrad; costa and sacculus fused, comprising approximate basal half of harpe, broadest in apical portion at point of attachment of arm of transtilla, gradually narrowing basad to rather narrowly rounded basal extremity, dorsal margin very heavily sclerotized; glabrous except for heavily punctate and setose, considerably expanded, subdigitate, caudal portion of sacculus; cucullus partially separated from costa and sacculus by dorsal constriction and ventral area of reduced sclerotization, comprising apical half of harpe, commonly curving somewhat ventrad and mesad, markedly constricted dorsad near base, major apical portion rather broad, heavily punctate and setose ectad and entad except for glabrous dorsal portion of basal two-thirds, apex broadly and evenly to irregularly rounded.

Transtilla with arm approximately one-third as long as harpe, slender, linear to sublinear, well sclerotized, glabrous, rather closely subparallel with dorsal margin of costa, terminating considerably distad of basal extremity of harpe, apex slightly expanded and rounded.

Uncus prominently bifid, somewhat variable but very distinctive. Dorsal aspect: base large, heavily punctate and setose, partially set off from tegumen by lateral areas of reduced sclerotization; lateral margins well sclerotized, sublinear to sinuate, converging distad; angle of bifurcation narrowly rounded to acute; furcae with basal portions approximate, broad, strongly narrowing distad, heavily punctate and setose. Lateral aspect: furcae abruptly directed ventrad to ventrocephalad at angle of 90 degrees or more, broadly expanded, laterally flattened, subtriangular, punctate and setose, closely subparallel to weakly divergent ventrad, gradually narrowing to acute apices.

Gnathos paired, curving ventrocaudad, lateral and apical portions well sclerotized, large mesobasal portion membranous; arms flattened, densely scobinate entad, apical portions overlapping, apices rather narrowly rounded.

Anellus membranous, unarmed, juxta absent.

Aedeagus approximately three-fifths as long as harpe, considerably flattened dorsoventrad, sublinear in dorsal and ventral aspects, approximate apical third curving somewhat ventrad in lateral aspect, asymmetrical in all aspects, glabrous, base broadly and irregularly expanded laterad and ventrad, basal half tubular, apical half opening broadly and irregularly dextrad; apical portion consisting simply of one or two, elongate, slender, moderately sclerotized, dorsosinistral strips terminating acutely or subacutely.

Vesica large, membranous, armed with two prominent clusters of cornuti: cornuti variously sized, mostly large, heavily sclerotized and darkened, linear, with apices finely acute; basal cluster largest, located dorsodextrad near base of vesica, containing 4–13 cornuti; apical cluster smaller, located dextrad nearer apex of vesica, containing 2–8 cornuti. The number of cornuti in each cluster varies from specimen to specimen and thus constitutes the chief intraspecific variation to be found in the genitalia of this species (see the tabulation, below, for examples of this variation).

In the ♂ genitalia of all the individuals of *popeanellus* that have been examined, the presence of two distinct clusters of cornuti in the vesica has proved to be a consistent and positive specific character. However, these cornuti commonly vary in size and number between the two clusters of any one individual as well as between the corresponding clusters of any two individuals. Thus, they furnish a good example of an intergrading, intraspecific variation in regard to their sizes, numbers, and ratios between the basal and apical groups. This variation is illustrated by a sampling of 18 specimens listed in the following table.

TABLE 1.—*Intraspecific variation of cornuti in* A. popeanellus

	Cornuti		
Specimen	*Basal*	*Apical*	*Total*
1	13	5	18
2	10	6	16
3	9	2	11
4	8	7	15
5	8	6	14
6	8	6	14
7	8	3	11
8	7	8	15
9	7	7	14
10	7	6	13
11	7	5	12
12	7	5	12
13	7	2	9
14	6	5	11
15	6	3	9
16	5	4	9
17	4	5	9
18	4	4	8

The basal cluster may contain as few as 4 cornuti to as many as 13, the apical cluster may contain from 2 to 8, and the total for both clusters ranges from 8 to 18. The basal cluster usually contains the most cornuti, but occasionally its number is equaled or even exceeded by the number in the apical cluster. Individually, the cornuti vary in size from minute to very large. This variation is essentially nongeographic.

TYPE.—Two type specimens in the Academy of Natural Sciences of Philadelphia.

TYPE LOCALITY.—"Texas."

DISTRIBUTION.—This species has a very wide range. It has been reported from northern South America, Central America, and Mexico, as well as from the United States where it is quite common except in the northwestern states and the extreme north and west. It has been recorded from Arizona, New Mexico, and Texas northward through Oklahoma, Kansas, and Nebraska and eastward to Pennsylvania, New Jersey, North Carolina, and Florida.

SPECIMENS EXAMINED.—606, from 106 localities. Large series containing both sexes are to be found in the collections of the author, the American Museum of Natural History, and the University of Kansas. At least one quarter of all the specimens accumulated for this study eventually proved to be *A. popeanellus*, and the number of specimens available for study has made it advisable to reduce the distributional data for this common species simply to the localities and months of occurrence:

ALABAMA: Gurley (July); Huntsville (July); Valley Head (Aug.). ARIZONA: Chiricahua Mountains (July); Douglas (Aug.); San Bernardino Ranch, Cochise Co. (Aug.); Tombstone (Aug.); Tucson (July). ARKANSAS: Camp Chaffee (Aug.); Hope (Aug.). FLORIDA: Key Largo (Aug.); Sanford (June); Winter Park (May, June). GEORGIA: Bainbridge (Sept.); Catoosa Co. (Aug.); Clarke Co. (Aug.); Screven Co. (July, an unusually small ♀); Tallapoosa (July). ILLINOIS: Champaign-Urbana (June and July, both sexes very common at light); Dubois (July); Havana (June); Homer Park, Homer (June, July); Lawrenceville (Sept.); Murphysboro (Aug.); Oakwood (July); Palos Park (July); Parker (July). Peoria (June, July); Putnam County (June, July, Aug.); Quincy (June). INDIANA: Putnamville (July); Tremont (June). IOWA: Denison (June); Des Moines (July, Aug.); Linn Co. (no date); Sioux City (June, July). KANSAS: Barton County (June); Bourbon Co. (no date); Caldwell (May, June, Aug.); Clark Co. (May, June); Decatur Co. (July); Douglas Co. (June and July, 2 ♂♂ with mites on abdomen); Gove Co. (no date); Linn Co. (no date); Manhattan (June); Medora (June); Ness Co. (July); Onaga (July); Republic Co. (July); Riley Co. (July); Scott City (June); Scott Co. (June, 1 ♂ with mite on eye); Sheridan Co. (no date); Topeka (no date). KENTUCKY: Harrodsburg (Aug.). MISSISSIPPI: Starkville (July); A. & M. College, State College (Aug.). MISSOURI: Brentwood (June); Kirkwood (May, June, July); Mineola (July); Ranken (June); St. Louis (July); Webster Groves (July); Willard (June). NEBRASKA: Lincoln (June, July, Aug.). NEW JERSEY: Vineland (no date). NEW MEXICO: Artesia (July); Carlsbad Caves, Carlsbad (July); Chaves Co. (July); Deming (July); Eddy Co. (July); Las Cruces (Aug.); Lordsburg (Aug.); Mesilla (July); State

College (July, Aug., Sept.). North Carolina: Hickory (July, Aug.); Kinston (Aug.); Maxton (May); Raleigh (June, July, Aug., Sept.); Wilkesboro (Aug.). Ohio: Granville (July). Oklahoma: Bartlesville (July); Clinton (June); Eagletown (June). Pennsylvania: Finleyville (July); Manoa, Delaware Co. (July). South Carolina: Myrtle Beach (June, July). Tennessee: Memphis (Aug.); Monteagle (July, Aug.); Nashville (July). Texas: Brownsville (June); Burnet Co. (July); Christoval (June); College Station (Oct.); Comfort (May, Sept.); Corpus Christi (Sept., Oct.); Davis Mountains (Aug.); Devils River, near Del Rio (May); Eastland Co. (April); Kingsville (June); Marathon (July); New Braunfels (May); Palo Duro State Park, Randall Co. (Aug.); Richmond (June); San Angelo (June). Virginia: Salem (Aug.).

Remarks.—*A. popeanellus*, one of the first three acrolophids described from the United States, is undoubtedly our commonest and most widely distributed species and is one of the larger and more robust acrolophids occurring in North America. It also exhibits considerable variation in size and coloration. These four factors explain why *popeanellus* is also the most heavily synonymized North American acrolophid.

A. popeanellus is closely related to *klotsi*, the two comprising a small species group in general related to those acrolophids having elongate labial palpi, setose eyes, laminate antennae, bifid uncus, and paired gnathos. However, *popeanellus* and *klotsi* may be distinguished from each other and from all other acrolophids on the basis of their aedeagi and unci. The latter organ, in the *popeanellus-klotsi* group, is distinctive in having its furcae abruptly directed or curved very strongly ventrad. In *popeanellus*, these furcae, easily observable in dried and undissected specimens, are characteristically expanded into subtriangular plates. The genital characters of *popeanellus* are consistent throughout my very large series and they are quite distinct from those of all the other species treated here.

I have not examined the type specimens of this species. Busck (1903), in his report on Clemens' types of Tineina in the Academy of Natural Sciences of Philadelphia, noted:

> *Anaphora popeanella* Clemens. Two types, both rubbed, one unspread and without abdomen; the other spread, and lacking the head and left wings. Clemens' No. 11; alar exp., 28 mm. Like the present conception of *Anaphora popeanella*, as determined by Walsingham and synonymous with *scardina* Zeller, and with *agrotipennella* Grote. A specimen compared with the type is in the U.S. National Museum. Habitat: Eastern United States.

Darlington located one of these type specimens at Philadelphia, and described it (in litt., 1946) as: "*popeanella* Clem. Type. Right wings only, poor condition, much rubbed, sex not determined." The combined information that I have been able to gather in regard to *popeanellus* leaves no doubt in my mind as to the proper identity and correct concept of this species. The specimens of *popeanellus* in the U.S. National Museum agree with my previous concept of this moth. In

addition, at the Museum are several slide preparations of ♂ genitalia, labeled "*popeanellus* Clem.," agreeing with my figures of this species.

Clemens apparently named this moth after Captain Pope. Walsingham (1887, pp. 155–156) designated this species as the type of Clemens' genus, *Anaphora*, and ten years later (1897) reported that the larvae of *popeanellus* attack the roots of *Trifolium pratense* in April and May, and that this insect also occurs in the West Indies (Puerto Rico).

Grote described the ♂ of *Anaphora agrotipennella* as a new species in July 1872. The locality given was "Central Alabama" where Grote reported the moth to be very common in June and July. An alar expanse of 27 mm. was listed.

Following the description Grote stated:

> I have only seen males of this species, in which the ornamentation of the fore wings above recalls that of various species of *Agrotis*, such as *A. jaculifera*, etc. I have tried to recognize in this species *A. Popeanella*, Clemens, from Texas, but I have failed to reconcile his description with my specimens, which are not "luteous or yellow along inner margin." In *A. agrotipennella*, at the extremity of the median ochrey shade subterminally, are a few black scale points. These can hardly be the same as the row "of dark brown spots" of *Popeanella*. Neither can I, from the description, consider the differences of colour and ornamentation as produced by any defect in the condition of Dr. Clemens' specimens.

Grote, describing the ♀ of *Anaphora agrotipennella* in August 1872, further attempted to differentiate his species from Clemens' *popeanella*.

When Walsingham (1887) placed it as a synonym of *popeanella*, he stated:

> An examination of my extensive series shows that both varieties belong to the same species. The anal appendages do not differ, and intermediate variations of colouring are noticeable. There can be no doubt that they differ only in the extension of the pale colour of the fold in the direction of the dorsal margin.

Walsingham also added that Zeller had evidently regarded the two as synonymous. Since 1887, *agrotipennella* has been generally treated by writers as a synonym of *popeanellus*, although Barnes & McDunnough (1917) and McDunnough (1939) maintained it as a distinct and valid species in their checklists.

I have not seen the type specimen, which is in the collection of the Academy of Natural Sciences, but Darlington, in 1946, reported it to be in perfect condition.

All the specimens labeled "*agrotipennellus*" that I have ever seen proved, upon examination of their genitalia, to be examples of *popeanellus*. Likewise, there is no indication in Grote's descriptions that his *agrotipennella* could not be *popeanellus*. In addition, there is no North American species available, save *popeanellus*, to represent Grote's descriptions of *agrotipennella*. It thus seems best to consider *agrotipennellus* an old synonym of *popeanellus* (Clemens) with Walsingham receiving the credit for sinking it.

Zeller described *Anaphora scardina* as a questionably new species in 1873. At the conclusion of his discussion of Clemens' genus *Anaphora*, Zeller said of his own series of specimens: "Whether I have Clemens' species among my own before me, I cannot decide with certainty from his descriptions; therefore I am giving the latter under separate names." He then proceeded to describe *scardina* and *bombycina* at considerable length. That Zeller was uncertain of the validity of his species, *scardina*, is evidenced by the fact that immediately beneath its designation at the head of the original description he inserted "? *Popeanella* Clemens" rather than listing it as "n. sp." He gave the "Vaterland" or locality as Texas and Carolina, where *popeanellus* is quite prevalent, and also mentioned that the largest example of all in his collection was from an unknown locality, thus indicating the possibility of a mixture of species. Chambers (1878), following Zeller's note of caution, gave the listing "*A. scardina*, Zell. =? *popeanella*, Clem." Walsingham (1887), after studying Zeller's specimens, placed *scardina* in the synonymy of *popeanella*, where it has since consistently appeared.

However, the type material for *scardina*, now in the British Museum (Natural History), presents a considerably different situation. One of the three photographs furnished by Tams is labeled "*scardina* Zell., type ♂" and easily but inconclusively passes for an adult *popeanellus*. Likewise, a second photograph labeled "*scardina* Zell." represents a ventral view of the complete ♂ genitalia of a specimen which is clearly and unmistakably *popeanellus*. On the other hand, the third photograph, also representing a set of genitalia and labeled "*scardina* Zell., type ♂," certainly does not represent *popeanellus*, nor does it agree with any other known North American species of *Acrolophus*. Hence, it is quite probable that Zeller's *scardina* is actually a valid species of *Acrolophus*, although not referable to *popeanellus* or any other North American species. It also seems fairly certain that Zeller's original series of *scardina* contained at least two species of *Acrolophus:* one, *popeanellus*, from Texas (also the locality of Clemens' original specimens of *popeanellus*) and Carolina; the other, apparently designated by Zeller as the type of *scardina*, from parts unknown. The latter may well be the large example of unknown origin mentioned in Zeller's original description.

Although *scardina* has long been considered an old synonym of *popeanellus*, the type specimen indicates it does not belong to that segment of the genus occurring north of Mexico. The name is spelled *scardinus* to agree grammatically with its present genus, *Acrolophus*.

Walsingham (1887) described *Anaphora morrisoni* as a new species on the basis of two ♂♂ collected in Florida by Herbert Knowles Morrison. The alar expanse given was 18 mm. He apparently

named the species after the collector, who died in 1885. Since 1887, *morrisoni* has consistently appeared in the literature as a distinct species. Walsingham's illustrations of the ♂ genitalia of *morrisoni*, showing the uncus and the cucullus of the harpe in both lateral and dorsal aspects, are essentially the same as his corresponding figures of the ♂ genitalia of *popeanellus*. On the preceding page of his revision, Walsingham had separated the two species as follows:

1. Points of the uncus distinctly separate—*popeanella*.
2. Points of the uncus closely approximate—*morrisoni*.

This difference is easily absorbed in the range of intraspecific variation exhibited by *popeanellus*.

The type ♂ is at the British Museum (Natural History), from which tams has sent two photographs, labeled "*morrisoni* Wals., type ♂." These show, through a dorsal view of the pinned moth and a ventral view of its entire genital capsule, that it is simply a small but typical Floridian specimen of *popeanellus*. Thus, *morrisoni* (Walsingham) should be considered a new synonym of *popeanellus* (Clemens).

Beutenmüller's manuscript name, *Acrolophus confusellus*, first appeared in print in 1891 in Smith's checklist, where it appeared as a valid species. Dyar (1900) referred to the name in Smith's list as "*confusellus*, Beut. (*ined.*)," indicating it was unpublished. In addition, Dyar validated *confusellus* by properly synonymizing it with the older species "*Anaphora popeanella*, Clemens," so that it emerged as *Anaphora confusellus* Dyar. He then, however, treated it as a form, stating:

> The form *confusellus* is smaller than the usual form, the ground colour lighter and more purplish, the dark marks strongly relieved. In genitalia there is no marked difference. The form differs from *popeanella* about as much as *Acrolophus cervinus*, Wals., does from *A. plumifrontellus*, Clem. U.S. Nat. Mus., type No. 405. Georgia (Beutenmüller's type).

It is obvious from the statement that Dyar had Beutenmüller's manuscript type specimen (chirotype) available for study, and it is interesting to note that *confusellus* and *cervinus* actually are synonyms of *popeanellus* and *plumifrontellus*, respectively. In 1903, the combination appeared as a distinct and valid species in Dyar's checklist; presumably, the statement quoted above was now intended to serve as the basis for considering *confusellus* a separate species. Thus, *confusellus* was elevated from chironym to synonym to form to species. Since 1903, *confusellus* has consistently appeared in the literature as a distinct species. Forbes (1923, p. 121) listed "*confusellus* Beutenmüller" as a synonym of *popeanellus* but also treated "*confusellus* Dyar" as a separate species.

There is no indication that Beutenmüller actually did publish a description of *confusellus*. He invariably described his new species in

this group under *Acrolophus*, and the combination, *Acrolophus confusellus* Beutenmüller, is not listed in the Zoological Record between the years 1891, when it first appeared in Smith's checklist, and 1886, when Beutenmüller's name first appeared as an author in the Zoological Record.

It is fairly obvious from Dyar's "description" of *confusellus* that it is simply a specimen of *popeanellus*. The type ♂, at the U.S. National Museum, where I was able to examine it, is labeled "*Acrolophus confusella* (Beut.) Dyar, type no. 405, Georgia, Beutenmueller Collection." The genitalia, removed and mounted on a slide by Busck on Oct. 12, 1933, confirm the identity of *confusellus* with *popeanellus*, and this is further confirmed by several slides of ♂ genitalia of "cotypes" of *confusellus* that also proved to be *popeanellus*. Thus, *confusellus* (Dyar) should be considered a new synonym of *popeanellus* (Clemens), Dyar having changed his original and correct placement.

12. *Acrolophus acanthogonus* Meyrick, *incertae sedis*

Acrolophus acanthogona Meyrick, 1919, Exotic Microlep., vol. 2, no. 9, p. 279, Nov.—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 103, no. 9571.

Meyrick's original description follows:

Acrolophus acanthogona—♂. 28 mm. Head, palpi, thorax fuscous; structure of palpi and antennae quite as in *popeanella*. Abdomen light fuscous; genitalia similar to *popeanella*, but angle of uncus furnished with a strong acute-triangular projection, points appressed together throughout, valvae with apex broad, slightly rounded. Forewings elongate, posteriorly somewhat dilated, costa gently arched, apex rounded-obtuse, termen rounded, somewhat oblique; fuscous, irregularly sprinkled dark fuscous; some indistinct small cloudy dark fuscous strigulae along costa; some slight whitish suffusion on fold, and two or three dark fuscous strigulae beneath it towards base; submedian and postmedian spots indicated by some irregular dark fuscous irroration; one or two small indistinct spots of dark fuscous irroration towards termen above middle; a terminal series of small indistinct spots of dark fuscous irroration: cilia fuscous (imperfect). Hindwings dark grey, rather lighter anteriorly; cilia greyish, a darker subbasal shade.

Texas; one specimen. Nearly allied to *popeanella*, but forewings slightly broader posteriorly, more uniformly coloured, and easily distinguished by genitalia.

This species, based on a single ♂ specimen from Texas, is treated here as *incertae sedis*, since no specimen is available for study. The name should be spelled *acanthogonus* to agree grammatically with its genus, *Acrolophus*. Mr. Tams of the British Museum (Natural History), where the type is located, originally sent photographs of both this moth and its genitalia. Later, when Dr. J. F. Gates Clarke of the U.S. National Museum studied Meyrick's types at the British Museum (Natural History), the genitalia of *acanthogonus* were remounted and again photographed in clearer detail. Dr. Clarke loaned two photographs of *acanthogonus*, one showing the genitalia in ventral aspect,

the other showing the aedeagus which by then had been removed and photographed separately. These four photographs and the original description represent all of the information that I have been able to gather regarding this species.

Following his description, Meyrick noted that *acanthogonus* is "nearly allied" to *popeanellus* (Clemens), also described from Texas. Actually, there is little in Meyrick's description which could with certainty be used to separate the two species. All of the distinctions he makes easily fall within the considerable range of intraspecific variation that I have observed in *popeanellus*. In addition, the photograph of the adult is inconclusive and could easily represent an example of *popeanellus*.

However, the photographs of the genitalia indicate that although *acanthogonus* is very closely related to *popeanellus*, it is apparently a distinct species. The chief differences lie in the structure of the aedeagus which, in *acanthogonus*, is rather elongate, slender, and almost entirely unexpanded at the base. Its vesica appears to be unarmed and lacks the basal and apical clusters of cornuti so prominent and characteristic in *popeanellus*. In addition, the cucullus of the harpe is shorter, broader, and more expanded in the apical portion than it is in *popeanellus*. Lastly, the furcae of the uncus are more prominently expanded dorsocaudad than in most of the examples of *popeanellus* that I have seen. Thus, *acanthogonus* appears to be distinct.

I have been unable to locate any specimens with genitalia comparable to those shown in the photographs representing *acanthogonus*. I have numerous specimens of *popeanellus* from Texas, but no example of *acanthogonus* is among them, since dissections of these specimens have consistently revealed the typical aedeagus of *popeanellus*. Because the material available seems hardly sufficient for making a proper diagnosis of *acanthogonus*, I must remain uncertain of its identity and proper position. It undoubtedly belongs to the *popeanellus* species group and, on the basis of its external features and uncus, would emerge with *popeanellus* at the same point in my key. It could then presumably be separated from *popeanellus* by means of its aedeagus. Perhaps, like *Acrolophus fervidus* Busck, it is predominantly a Mexican species occurring only infrequently north of the Rio Grande.

13. *Acrolophus klotsi*, new species

FIGURES 65–69

MALE.—Coloration and external structures generally similar to those of *popeanellus*. Head, antennae, and thorax ochreous. Labial palpi elongate, recurved back over head and extending almost to posterior margin of thorax, densely clothed with scales, basal portions

closely appressed to head and to each other, apical portions gradually diverging from thorax and from each other, inner surfaces ochreous, outer surfaces becoming progressively fuscous basad, central and apical segments plumose and fringed with grayish-white distad. Eyes moderately large and protruding, setose, without lashes. Antennae simple, laminate, covered dorsad with scales, segmental processes set closely together throughout antennae. Forewings with coloration quite variable, commonly rich brown with diffused luteous patches below fold and in apical third. Hindwings, fringes, and abdomen varying shades of brown. Wing expanse: 22 to 30 mm.

FEMALE.—Coloration variable as in ♂, color pattern comparatively reduced. Labial palpi short, porrect, densely clothed with scales, basal and central portions closely appressed, apical portions divergent, inner surfaces ochreous, outer surfaces suffused with fuscous. Eyes essentially same as those of ♂. Antennae similar to those of ♂ except more slender and covered dorsolaterad with scales. Forewings variable in coloration, commonly brown with luteous patches as in ♂, commonly dark brown to pale brown with little or no color pattern. Hindwings, fringes, and abdomen dark brown to pale brown. Wing expanse: 30 to 38 mm.

MALE GENITALIA.—Vinculum typical.

Tegumen with lateral arm broad, narrowing considerably toward base, mesal portion punctate; dorsal area broad, mesal portion glabrous.

Harpe simple. Lateral aspect: sublinear, broadest in central area. Costa and sacculus fused, broad, comprising basal half of harpe, glabrous except for heavily punctate and setose ventrocaudal margin of sacculus, narrowing gradually to base. Cucullus set off from costa and sacculus by constrictions and areas of reduced sclerotization, comprising apical half of harpe, heavily punctate except for glabrous dorsal area along basal two-thirds, basal portion slightly constricted; apex somewhat narrowed, rounded.

Transtilla with arm typical; sinuate, glabrous, approximately two-sevenths as long as harpe, terminating above base of harpe.

Uncus bifid. Dorsal aspect: base with deeply emarginate cephalic margin occupied by large and subtriangular caudal extension of tegumen, lateral areas punctate, lateral margins sublinear and convergent; angle of bifurcation very narrow, acute; furcae rather short, robust (but not laterally flattened), narrowly separated, slightly divergent, gradually narrowing distad, directed strongly ventrad, apices acute.

Gnathos paired, typical; arms rather narrow, directed ventrocaudad, well sclerotized, apical thirds minutely scobinate and overlapping, apices rounded.

Anellus large, membranous but slightly thickened, glabrous, juxta absent.

Aedeagus rather short and stout, asymmetrical, glabrous, slightly sinuate, base expanded circularly, basal two-fifths cylindrical; apical three-fifths consisting simply of narrow, well sclerotized, sinistral projection gently curving ventrad and narrowing to acute apex; base of this projection marked by prominent, nodelike expansion of left wall of aedeagus as seen in dorsal and ventral aspects.

Vesica large, membranous, extending slightly beyond sinistral projection of aedeagus, dextral surface armed with single large cornutus. Cornutus arising from mesal portion of vesica, extending caudad almost to apex of vesica, elongate, slender, heavily sclerotized, base slightly expanded, apex acute.

TYPE.—Holotype ♂ and allotype ♀ (type no. 61436) in the U.S. National Museum.

PARATYPES (74 ♂♂, 11 ♀♀).—American Museum of Natural History (24 ♂♂, 3 ♀♀); California Academy of Sciences (37 ♂♂, 6 ♀♀); Cornell University (4 ♂♂, 2 ♀♀); U.S. National Museum (3 ♂♂); University of Arizona (Agr. Exp. Sta.) (2 ♂♂); University of Kansas (4 ♂♂).

TYPE LOCALITY.—Tucson, Pima Co., Ariz. (July 20, E. A. Schwarz).

DISTRIBUTION.—Southwestern United States. Arizona and (?) New Mexico.

SPECIMENS EXAMINED.—87 (75 ♂♂, 12 ♀♀), from 8 localities:

ARIZONA: "Babaquivera" Mts., Pima Co., ♂ (Aug., collector unknown); Babaquivari Mts., Pima Co., 2 ♂♂ (July 15–30, 1924, O. C. Poling); Badger, Santa Cruz Co., 13 ♂♂ (July 31, 1924, E. P. Van Duzee and J. O. Martin); Douglas, Cochise Co., 2 ♂♂ (Aug., F. H. Snow); Patagonia, Santa Cruz Co., 14 ♂♂, 2 ♀♀ (Aug. 1–2, 1924, 2 ♂♂ with mites on abdomen, E. P. Van Duzee); Santa Catalina Mts., ♂ (Sabino Canyon, Aug. 12, 1924, E. P. Van Duzee); Santa Cruz Co., ♂ (Aug. 4, 1927, R. H. Beamer); Tucson, ♂, ♀ (July 20, E.A. Schwarz), ♂ (July 22, 1917, coll. unknown), 9 ♂♂, 4 ♀♀ (St. Xavier Monument, July 29, 1924, E. P. Van Duzee), ♂ (July 25, 1925, at light, 2400 feet, R. B. Streets), ♂ (Aug. 1, 1925, at light, 2400 feet, A. A. Nichol), 8 ♂♂ (July 30, 1937, one specimen with mite on antenna, A. B. Klots), 3 ♂♂, 2 ♀♀ (Oct. 8–10, 1939, Crandall), 16 ♂♂, 3 ♀♀ (July 19 to Aug. 3, 1943, Coll. Fred H. Rindge). NEW MEXICO: Santa Cruz, Santa Fe Co., ♂ (Aug. 20, 1927, R. H. Beamer) (this locality record may possibly be in error).

REMARKS.—The locality records show that this species has been recorded almost exclusively from southern Arizona, where it is quite abundant in the vicinity of Tucson and other parts of Pima County and ranges southward into Mexico. It is one of the larger and more robust acrolophids. *A. klotsi* has not been previously described, probably because of its marked but superficial resemblance to *popeanellus* which also occurs in Tucson and other sections of Arizona.

A. klotsi is related to *popeanellus*, the two comprising a small species group characterized in the foregoing remarks on *popeanellus*. These two species may be easily distinguished from each other, as well as from all other acrolophids, on the basis of their aedeagi and unci. In *klotsi*, the vesica of the aedeagus is armed with only one large cornutus as compared with the two large clusters of cornuti in the vesica of *popeanellus*. Likewise, in *klotsi*, the furcae of the uncus, although curving strongly ventrad, are neither expanded nor flattened like those of *popeanellus*. Lastly, the labial palpi of *klotsi* are somewhat shorter than those of *popeanellus*. The genital characters of *klotsi* are consistent throughout my fairly large series and they are quite distinct from those of all the other species treated here.

This species is named in honor of Dr. Alexander B. Klots, Research Associate in the Department of Insects and Spiders at the American Museum of Natural History. Dr. Klots has supplied me with a large series of acrolophids, which included representatives of a number of new species.

14. *Acrolophus propinquus* (Walsingham)

FIGURES 70–82

Anaphora propinqua Walsingham, 1887, Trans. Ent. Soc. London, p. 157, June.—Smith, 1891, List Lep. Bor. Amer., p. 95, no. 5060.—Dyar, 1900, Can. Ent., vol. 32, no. 11, p. 327; 1903, List North Amer. Lep., p. 578, no. 6591.

Anaphora tenuis Walsingham, 1887, Trans. Ent. Soc. London, p. 164, pl. 8, fig. 18, June.—Smith, 1891, List Lep. Bor. Amer., p. 95, no. 5062.—Dyar, 1900, Can. Ent., vol. 32, no. 11, pp. 326–327; 1903, List North Amer. Lep., p. 579, no. 6595. (New synonymy.)

Acrolophus violaceellus Beutenmüller, 1887, Ent. Amer., vol. 3, no. 7, p. 139, Oct.—Smith, 1891, List Lep. Bor. Amer., p. 94, no. 5055.—Dyar, 1900, Can. Ent., vol. 32, no. 10, pp. 308–309; 1900, Can. Ent., vol. 32, no. 11, 326 (syn.).—Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8186 (syn.).—Forbes, 1923, Lep. New York, p. 121 (syn.).—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 103, no. 9576 (syn.). (New synonymy.)

Anaphora violaceellus Dyar, 1903, List North Amer. Lep., p. 579, no. 6595 (syn.).

Anaphora buscklella (♀) Haimbach, 1915, Ent. News, vol. 26, no. 7, p. 325, pl. 12, fig. 11, July. (New synonymy.)

Acrolophus propinquus Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8181.—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 103, no. 9567.

Acrolophus buscklellus Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8183.—Forbes, 1923, Lep. New York, p. 121 (syn. ?).—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 103, no. 9569.

Acrolophus tenuis Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8186.—Forbes, 1923, Lep. New York, pp. 120–121.—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 103, no. 9576.

Walsingham's original description follows:

Anaphora propinqua—*Palpi* recurved, reaching to the posterior margin of the thorax, purplish fuscous. *Antennae* cinereous, stout, serrated, the ends of the articles being fringed with delicate hairs. *Head, thorax,* and *fore wings* purplish fuscous, the latter without conspicuous markings, the usual discal and apical spots being indicated by dark fuscous scales; no ferruginous shade on fold or disc; a few irregularly distributed white scales, single or in groups of two to four, are noticeable on the outer portion of the wing and on the end of the fold; these appear to be loosely attached and very fugitive; apical vein not forked. *Hind wings* greyish fuscous-cinereous. *Abdomen* purplish fuscous; the lateral claspers of much the same form as in *morrisoni*. The uncus is double, arched over, not angulated, and with the points closely approximate; differing very decidedly in form from that of *morrisoni*, from which species the whole insect is otherwise scarcely distinguishable. *Exp. al.* 18 mm.

Florida (Morrison); two males.

MALE GENITALIA.—Vinculum typical, as in other species.

Tegumen with lateral arm of medium length, broad, basal portion glabrous, becoming rather heavily punctate dorsocaudad, margins heavily sclerotized and sinuate, strongly narrowing to point of attachment with vinculum; dorsal area broad, punctate laterad, with cephalic margin deeply but narrowly emarginate mesad, caudal margin produced mesad into and fusing with base of uncus.

Harpe simple, somewhat variable. Lateral aspect: rather broad, sublinear to curving slightly ventrad, with slight to pronounced ventral constriction near center; costa and sacculus fused, comprising approximate basal half of harpe; glabrous except for heavily punctate and setose, considerably expanded, ventrocaudal margin of sacculus; broadest in apical third, approximate basal two-thirds irregularly narrowing basad to subacute basal extremity; cucullus partially set off from costa and sacculus by irregular areas of reduced sclerotization, comprising apical half of harpe, rather broad, apical half commonly broader than basal half, heavily punctate and setose ectad and entad except for glabrous dorsal portion of basal two-thirds, apex broad and evenly rounded to narrowed and narrowly rounded.

Transtilla with arm variable, of medium width and length, well sclerotized, glabrous, sublinear to sinuate, major basal portion slightly convergent with to slightly divergent from dorsal margin of costa, approximate apical third strongly converging with to strongly diverging from costa, terminating subacutely to acutely considerably distad of basal extremity of harpe.

Uncus bifid, occasionally asymmetrically so, figure 77. Dorsal aspect: base rather large, partially set off from tegumen by areas of reduced sclerotization; heavily punctate and setose except for small, glabrous, mesobasal area; lateral margins heavily sclerotized, sinuate,

weakly converging distad; angle of bifurcation rather narrow to rather broad; furcae rather short, of medium width, tubular, well sclerotized, heavily punctate and setose, rather broadly separated, diverging distad, curving ventrad and gradually narrowing to acute apices.

Gnathos typically paired, with lateral and apical portions heavily sclerotized, curving ventrocaudad; arms rather broad, flattened, finely scobinate entad, apical portions parallel to partially overlapping, apices broadly and evenly rounded.

Anellus membranous, unarmed or with very weakly sclerotized medioventral area possibly representing trace of juxta.

Aedeagus rather small and slender, approximately two-thirds as long as harpe, asymmetrical and somewhat sinuate in all aspects, glabrous, base weakly expanded laterad and emarginate ventrad, approximate basal half cylindrical, apical half opening broadly dextrad and consisting simply of well sclerotized sinistral wall, apex narrowly rounded to subacute.

Vesica large, membranous, usually unarmed; occasionally armed in central or dextral portion with one to at least five, extremely small, variously shaped, acute cornuti.

TYPE.—Type ♂ in the British Museum (Natural History).

TYPE LOCALITY.—"Florida."

DISTRIBUTION.—Central and eastern United States. Missouri and Arkansas eastward to Massachusetts and Florida.

SPECIMENS EXAMINED.—156, from 43 localities. The large number of specimens available for study has made it advisable to reduce the distributional data for this fairly common species largely to the localities and months of occurrence:

ALABAMA: La Place, near Tuskegee (June); Leroy (June). ARKANSAS: Camden (June). FLORIDA: Fort Myers (April); Gainesville (June & July, trap-light); Lake Placid (July, Archbold Biological Station); Merritt Island (Sept.); Okeelanta (May); Orlando (June, at light); Punta Gorda (April); Winter Park (May, June, July). GEORGIA: (?) Chessar's Island (June); Clayton (May, 2000 feet); Rabun Co. (June); Screven Co. (July); Spring Creek, Decatur Co. (June). ILLINOIS: Champaign-Urbana (June and July, both sexes frequent at light in June); Chicago (June, July); Dubois (July, at light); Edgebrook (June); Homer Park, Homer (June, at light); Mahomet (July, 2 ♂♂ "at sugar"); Palos Park (July, at light); Peoria (June, at light); Putnam County (June). INDIANA: Hessville (June, July). MASSACHUSETTS: Nantucket ("July 12–28," "Aug.1–Sept. 15"). MISSISSIPPI: Biloxi (June); Lucedale (June). MISSOURI: Kirkwood (June, July); Mineola (July); St. Louis (June). NEW JERSEY: Browns Mills (June, July); Lakehurst (July); Lakewood (July). NORTH CAROLINA: Brevard (June); Maxton (May and Sept., 1 ♂ with mites on abdomen, 1 ♂ with uncus abnormally broadened); Raleigh (June); Smokemont (June). OHIO: Granville (July). PENNSYLVANIA: Finleyville (June); Wall (no date). SOUTH CAROLINA: Myrtle Beach (June, July).

REMARKS.—In addition to being widely distributed and fairly common, *propinquus* exhibits marked variation in size and coloration. These factors undoubtedly account for its relatively large synonymy. The material representing this species was received on loan from numerous sources. Good series containing both sexes are to be found in the collections of the author, the American Museum of Natural History, and Cornell University.

Although not closely related to any other acrolophid, *propinquus* is related to those species having elongate labial palpi, setose eyes, laminate antennae, bifid uncus, and paired gnathos. The harpe and the base of the uncus exhibit the most variation. However, the aedeagus of *propinquus* has proved to be relatively uniform. Thus, the characters to be found in the genitalia of *propinquus* are sufficiently distinct from those of all other acrolophids treated in this work. The variations exhibited by this species may indicate that it is in the process of speciation.

Photographs from Tams labeled "*propinquus* Wals., type" show the adult ♂ and its genitalia. These photographs easily confirm the identity of this species. Several slides of ♂ genitalia labeled "*propinquus* Wlsm." are in the U.S. National Museum. Upon examination of these, I found that they agreed with my concept of this species.

In his revision of 1887, Walsingham described *Anaphora propinqua* and *Anaphora tenuis* as new species on pages 157 and 164 respectively. He based his description of *tenuis* on seven ♂♂ collected in North Carolina by Morrison and a single ♂ without locality in Zeller's collection. The alar expanse for *tenuis* was listed as 24 mm. Walsingham's illustrations of the ♂ genitalia of *tenuis* showed the uncus and the cucullus of the harpe in lateral aspect and the uncus alone in dorsal aspect. Since 1887, *tenuis* has appeared in the literature as a distinct species.

Actually, there is nothing in the description and illustrations of *tenuis* to indicate that it could not be *propinquus*. On page 157 of his revision, Walsingham, in his key to the species of *Anaphora*, separated the two essentially as follows:

a. With supplementary processes on each side of the uncus . . *tenuis*, Wlsm.
b. Without supplementary processes on each side of the uncus . *propinqua*, Wlsm.

The "character" used above by Walsingham is neither consistent nor of specific value. The lateral portions of the base of the uncus may vary considerably within a series of specimens of almost any one species, especially in the case of dried specimens.

The type ♂♂ of both *tenuis* and *propinquus* are at the British Museum. Photographs representing these types sent me by Mr. Tams show moths in dorsal aspect and their complete genital capsules in ventral aspect. These two sets of photographs undoubtedly

represent a single species. Thus, *tenuis* (Walsingham) should be considered a new synonym of *propinquus* (Walsingham), the difference in priority being seven pages of Walsingham's text.

Beutenmüller described *A. violaceellus* as a new species in 1887 only a few months after Walsingham had described *Anaphora propinqua* and *Anaphora tenuis*. Following his description of *violaceellus*, Beutenmüller noted: "Expanse of wings, ♂ 26 mm., ♀ 34 mm. 4 ♂ and 1 ♀. North Carolina. This species can be at once distinguished by its plain color, and violet reflection."

Smith (1891) included *Acrolophus violaceellus* as a distinct species in his check list. Dyar (1900, p. 309) at first related *violaceellus* with *arizonellus* when he said of the former: "The genitalia are not very different from those of *Arizonellus*, Wals., though the harpes may be somewhat slenderer. However, the moth differs in its uniform, unspotted, purplish colour." Shortly thereafter, Dyar (1900, p. 326) correctly placed *violaceellus* as a synonym of *tenuis* in stating: "In Can. Ent., XXXII., 309, I placed *Acrolophus violaceellus*, Beut., as a distinct species, but on further comparison I cannot distinguish it from *Anaphora tenuis*, Wals."

Since 1900, *violaceellus* has consistently appeared in the literature as a synonym of *tenuis*, which in turn I find is a synonym of *Acrolophus propinquus* (Walsingham).

Many of the specimens in my series of *propinquus* easily agree with Beutenmüller's original description of *violaceellus*. The type ♂ is at the U.S. National Museum and is labeled "*Acrolophus violaceellus* Beut., type no. 404, North Carolina, Beutenmueller Collection." It proved, upon examination, to be a typical specimen of *propinquus*. Thus, *violaceellus* Beutenmüller should be considered an old synonym of *tenuis*, with credit to Dyar, and a new synonym of *propinquus* (Walsingham).

Haimbach described the ♀ of *Anaphora busckella* as a new species in 1915. The single figure cited represented a dorsal view of the type specimen which was listed as retained in the author's collection. Haimbach's brief description is as follows:

> Alar expanse 33 mm. Primaries dark brown, with a violaceous tinge, a broad white stripe, also violaceous, at interior margin, speckled with dark brown irrorate spots. There are several blackish spots above the light stripe, the centre one of which partly covers the light stripe. Secondaries and cilia dark smoky brown. Undersides of wings uniformly dark smoky brown, without any ornamentation. One female taken at Jamesburg, New Jersey, July 4th. I am pleased to dedicate this distinct species to Mr. A. Busck, who kindly determined the genus for me, and in many other determinations gave me valuable assistance.

Since 1915, *busckellus* has appeared in the literature as a distinct species, although Forbes (1923), reporting it from Brown's Mills, New Jersey, incorrectly believed it to be a "black aberration" of

popeanellus. I have not seen the type ♀ which is now in the collection of the Academy of Natural Sciences in Philadelphia. Darlington (in litt., 1946) has reported: "*busckellus* Haim. Type. In perfect condition, unable to determine sex."

Haimbach's description and photograph are identical with a small series of specimens I have received from New Jersey (including Forbes' specimens from Brown's Mills), Georgia, and Alabama. The genitalia of these moths are identical with those of my large series of specimens previously determined as *A. propinquus* (Walsingham). The latter species has a wide range in the eastern United States with a number of rather striking geographical variations in both size and color pattern, although these invariably present essentially the same genital structure. *A. propinquus* has been described as new at least four times from North America, with *busckellus* (♀) (Haimbach) as its most recent synonym and perhaps its most striking color variation.

15. *Acrolophus macrogaster* (Walsingham)

In the southwestern United States three groups of moths exhibit essentially the same genital structure (see following description and illustrations) as shown in my copy of a British Museum photograph of genitalia labeled "*macrogaster* Wals., type ♂," described from Arizona. Their genitalia also agree with Walsingham's rather brief diagnosis of the ♂ genitalia in his original description of *macrogaster*. Despite this great similarity of genitalia throughout the complex, the three groups may be easily separated from one another, as well as from Walsingham's original conception of *macrogaster*, by external differences occurring in the antennae, labial palpi, and eyes. On the basis of limited material available for study, these differences among the structures of the head appear to be both nonintergrading and geographical in nature, thus indicating the presence of four subspecies. Three of these are described below as new under the names *bipectinicornus*, *unipectinicornus*, and *laminicornus*, names derived from the type of antennal structure peculiar to each of the subspecies.

According to the original description, Walsingham's ♂ *macrogaster* has a combination of the genitalia described below, bipectinate antennae, and labial palpi which are recurved, elongate, and "reaching nearly to the posterior edge of the thorax." However, I have seen no specimen with this combination of characters.

A unique ♂ specimen, *bipectinicornus*, from the U.S. National Museum, labeled "Colora'o, N.M., at light, July 10 (Ckll.) B 59," perhaps represents the closest approach I have seen to Walsingham's *macrogaster*. This specimen also has strongly bipectinate antennae, although the pectinations are not "wider at their bases than outwardly" as stated in his description. In addition, the labial palpi

of the New Mexican *bipectinicornus* are intermediate in length and extend only onto the anterior margin of the thorax. The basal segment is slightly longer than the central segment, while the apical segment is considerably reduced and less than two-thirds as long as the central segment. The eyes are not setose in *bipectinicornus*.

The two remaining subspecies, *unipectinicornus* and *laminicornus*, are similar to *macrogaster* except that their antennae are either unipectinate or laminate but never bipectinate. They may be distinguished from the New Mexican subspecies, *bipectinicornus*, in three ways: they lack bipectinate antennae; their eyes are obviously setose; and their labial palpi are longer and exhibit an apical segment longer than either the basal or central segments.

These last two subspecies may be separated from each other by their antennal structure. One, *unipectinicornus*, represented by four ♂♂ from Paradise and Douglas, Arizona, exhibits distinctly unipectinate antennae. The other, *laminicornus*, apparently the most prevalent of all and represented by thirteen ♂♂ and one ♀ from Tucson, Badger, and Patagonia, Arizona, has simple, laminate antennae.

The genitalia of *unipectinicornus* and *laminicornus* are essentially the same; the differences between the two subspecies are no greater than the variation exhibited within either one. The genitalia of the unique specimen from New Mexico, *bipectinicornus*, differ from the above in that the gnathos is considerably broader and is not cleft at the apex, and the central portion of the uncus and the cucullus of the harpe are noticeably broader in lateral aspect. The British Museum photograph of the ♂ genitalia of *macrogaster* is not in sufficient detail to show any appreciable differences between that subspecies and the three available for study.

The members of this complex show considerable variation in size and color pattern. The characteristic whitish patch on the posterior margin or "fold" of the forewing is usually present but varies in size and shape. It is sometimes greatly reduced, however, and is almost obsolete in *bipectinicornus*. Further collecting may show that geographical separation does not exist between two or more of these subspecies, thus reducing them to forms. Additional material may also show complete intergradation between two or more of the subspecies, thus reducing them to synonyms.

Key to Subspecies of the *A. macrogaster* Complex

(Based on Males)

1. Antennae bipectinate 2
   Antennae unipectinate or laminate 3

2. Labial palpi elongate, extending almost to posterior margin of thorax; antennae with pectinations wider at bases than outwardly.
macrogaster (Walsingham)

Labial palpi of intermediate length, extending only onto anterior margin of thorax; antennae with pectinations narrower at bases than outwardly.
bipectinicornus, new subspecies

3. Antennae unipectinate . . . . . **unipectinicornus,** new subspecies
Antennae laminate . . . . . **laminicornus,** new subspecies

15a. *Acrolophus macrogaster macrogaster* (Walsingham), new combination

Anaphora macrogaster Walsingham, 1887, Trans. Ent. Soc. London, p. 165, pl. 8, figs. 19, 19a, June.—Smith, 1891, List Lep. Bor. Amer., p. 95, no. 5063.—Dyar, 1900, Can. Ent., vol. 32, no. 11, p. 327; 1903, List North Amer. Lep., p. 579, no. 6596.

Acrolophus macrogaster Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8187.—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 103, no. 9577.

Walsingham's original description of *macrogaster* is quoted as follows:

Anaphora macrogaster—Labial palpi, ♂, recurved, reaching nearly to the posterior edge of the thorax; ♀ erect, reaching somewhat above the elongate basal joint of the antennae. *Antennae* ♂, bipectinate, the pectinations wider at their bases than outwardly, fringed with short hairs; subochreous; ♀ simple. *Head, thorax,* and *palpi* mottled greyish and brownish fuscous. *Fore wings* brownish fuscous, slightly mottled with paler along the costal and apical margins; with an elongate patch of dull whitish running irregularly along the length of the fold; a smaller spot of the same colour immediately beyond the outer end of the cell. *Hind wings* brown; the fringes scarcely paler. *Abdomen* the same colour as the hind wings, that of the male about 7 mm., of female 10 mm.; the lateral claspers of the male spoon-shaped, scarcely inverted, dilated outwardly, but tapering slightly upwards and rounded at the apex; uncus double, the points parallel and somewhat closely approximate. *Exp. al.* ♂, 22 mm.; ♀, 29 mm.

Three males and three females from Arizona, collected by Morrison.

Male genitalia essentially the same as those of *laminicornus*, described below.

REMARKS.—Walsingham's illustrations consisted of: figure 19 the adult ♀, dorsal aspect, in color; and figure 19a the ♂ genitalia—the uncus and cucullus in lateral aspect and the uncus in dorsal aspect. The type material, including both ♂♂ and ♀♀, is in the British Museum (Natural History). Mr. Tams of that institution has sent photographs, labeled "*macrogaster* Wals., type," showing an adult ♂ and ♀ and their genitalia. These, along with the original description, furnish a reasonably complete conception for *macrogaster*. Although I have never seen a specimen completely agreeing with this conception, I am considering this subspecies valid because its genitalia are apparently the same as those of the following three subspecies, which may be distinguished from one another, as well as from

macrogaster, on the basis of differences occurring in the antennae, labial palpi, and eyes.

15b. *Acrolophus macrogaster bipectinicornus*, new subspecies

Female unknown.

MALE.—Similar to *macrogaster* in habitus and general coloration. Labial palpi intermediate in length, closely appressed, recurved, extending only onto anterior margin of thorax, apical portions diverging slightly from head and from each other distad, basal segment slightly longer than central segment, apical segment considerably reduced and less than two-thirds as long as central segment. Eyes rather large and protruding, naked, posterior halves heavily lashed. Antennae strongly bipectinate; pectinations finely setose, narrower at bases than outwardly. Forewings with basal whitish patches almost obsolete. Hindwings pale brown, considerably paler than forewings. Genitalia similar to those of *laminicornus* with following exceptions: gnathos considerably broader, not cleft at apex; cucullus of harpe and central portion of uncus noticeably broader in lateral aspect. Expanse: 19 mm. A unique ♂ specimen from Colora'o, New Mexico, at light, July 10, T. D. A. Cockerell.

Holotype ♂, U.S. National Museum, type no. 61437. This subspecies may be distinguished from the others of the *macrogaster* complex by its combination of bipectinate antennae, from which the name is derived, and shortened labial palpi.

15c. *Acrolophus macrogaster unipectinicornus*, new subspecies

FIGURES 83–84

Female unknown.

MALE.—Similar to *macrogaster* in habitus and general coloration. Labial palpi elongate, recurved, extending to center of thorax, basal portions closely appressed to head and to each other, apical portions diverging from thorax and from each other distad, basal segment shorter than central segment, apical segment elongate and slightly longer than central segment. Eyes rather small, moderately setose, anterior and posterior portions well lashed. Antennae unipectinate; pectinations subcircular, finely setose, each separated from adjacent process by space at least equal to thickness of process. Ground color of forewings, hindwings, and abdomen brown. Abdomen with lateral tufts of whitish scales; tip clothed with elongate, slender, brownish scales. Genitalia, including harpe (fig. 83) and aedeagus (fig. 84), essentially same as those of *laminicornus*. Expanse: 20–23 mm. Four ♂♂ from Arizona.

Holotype ♂, U.S. National Museum, type no. 61438, from Paradise, Cochise Co., Ariz., July. The three remaining ♂♂ have been

designated as paratypes. One, also from Paradise and collected by O. C. Poling in June, was received from the Carnegie Museum. The other two are from the U.S. National Museum. Of these, one is from Douglas, Cochise Co., Ariz., July 1–7. The other, apparently from Lord Walsingham's collection and determined by him, bears a number of labels giving the following information: "♂—136, 1889, Wlsm. Coll.—Morrison, Arizona, 1881—Collection C. V. Riley—*Anaphora macrogaster* Wlsm."

REMARKS.—This subspecies may be distinguished from the others of the *macrogaster* complex by its unipectinate antennae, from which the name is derived. A single ♀, received from the University of Kansas and labeled "Douglas, Arizona, August, F. H. Snow," definitely represents one of the subspecies of *macrogaster*. However, it was not collected in conjunction with any of the ♂ specimens I have received for study, and thus can not be positively associated with *unipectinicornus*, also recorded from Douglas. Its external appearance is essentially the same as that of the ♀ of *laminicornus*, described below.

15d. *Acrolophus macrogaster laminicornus*, new subspecies

FIGURES 85–89

MALE.—Similar to *macrogaster* in habitus and general coloration. Labial palpi elongate, recurved, extending somewhat beyond center of thorax; diverging from head, thorax, and from each other distad; basal and central segments approximately equal in length, apical segment slightly longer than either. Eyes rather small, moderately setose, anterior and posterior portions lashed. Antennae simple, laminate; each process finely setose, laterally flattened, narrowly separated from adjacent processes. Ground color of wings and abdomen rich brown. Forewings with whitish patches large, prominent. Tip of abdomen with pair of prominent, lateral tufts; each tuft composed of numerous, elongate, slender, brown and white scales. Expanse: 17–21 mm.

FEMALE.—Similar to ♂ in general coloration. Labial palpi short, closely appressed, basal portions recurved, apical portions porrect. Eyes as in ♂, but less heavily lashed. Antennae as in ♂, but more slender. Tip of abdomen without tufts. Expanse: 28 mm. Thirteen ♂♂ and one ♀ from Pima and Santa Cruz Counties, Arizona.

MALE GENITALIA.—Vinculum distinctive, consisting mostly of ventral plate with caudal margin and laterocephalic extremities broadly and evenly rounded and cephalic margin broadly emarginate.

Tegumen broad, glabrous; lateral arm narrowing to point of articulation with vinculum, margins somewhat sinuate; dorsal area not

emarginate, mesal portion fusing indistinctly caudad with base of uncus.

Harpe simple. Lateral aspect: of medium length, broad, principal parts indistinctly fused, dorsal margin sublinear apicad of dorsal expansion at base of arm of transtilla, ventral margin sinuate, approximate apical third very heavily punctate ectad and entad, approximate central third glabrous except for sparsely punctate and setose dorsal and ventral areas on ental surface, basal portion glabrous and narrowing irregularly basad of point of attachment of arm of transtilla to narrow basal extremity, apex broadly and evenly rounded.

Transtilla with arm glabrous, well sclerotized, linear or sublinear, slightly more than one-fourth to one-third as long as harpe, parallel to or directed somewhat ventrad of longitudinal axis of main portion of harpe, increasingly divergent distad from margin of costa and with apex widely separated from basal extremity of harpe, terminating subacutely slightly to considerably beyond base of harpe.

Uncus bifid. Dorsal aspect: base large, glabrous, mesal portion rather weakly sclerotized; lateral margins heavily sclerotized, linear, evenly converging caudad into furcae; angle of bifurcation rather narrow, evenly rounded. Furcae rather elongate and slender, tubular, very sparsely punctate, evenly curving caudoventrad, rather closely subparallel, apical portions generally slightly convergent, apices acute and narrowly separated.

Gnathos paired but commonly obscurely so, possibly transitional between paired and fused types, directed caudoventrad; basal portion with mesal area broad and membranous, lateral margins heavily sclerotized and converging distad; apical portion well sclerotized, very heavily scobinate, lateral margins converging distad; apex clearly to rather obscurely cleft into two rather short arms with subacute apices.

Anellus membranous, unarmed, juxta absent.

Aedeagus slender, rather short, approximately two-thirds to almost three-fourths as long as harpe, glabrous, cylindrical, somewhat asymmetrical, sublinear in dorsal and ventral aspects, apical and basal portions curving slightly ventrad in lateral aspect; approximate basal fourth evenly expanded, opening broadly ventrad; remainder of aedeagus gradually narrowing to apex; approximate apical half to two-fifths opening lateroventrad, apex acute.

Vesica rather small, elongate, narrow, membranous, unarmed.

Holotype ♂, U.S. National Museum, type no. 61439, from St. Xavier Monument, Tucson, Pima Co., Ariz., August 12, 1924, J. O. Martin. The remaining 12 ♂♂ and 1 ♀, all from the Department of Entomology, California Academy of Sciences, have been designated as paratypes and bear the following data: St. Xavier

Monument, July 29, 1924, 3 ♂♂, J. O. Martin, 2 ♂♂, E. P. Van Duzee, August 12, 2 ♂♂, J. O. Martin; Badger, Santa Cruz Co., Ariz., July 31, 1924, 2 ♂♂, E. P. Van Duzee, 1 ♂ and 1 ♀, J. O. Martin; Patagonia, Santa Cruz Co., Ariz., August 2, 1924, 2 ♂♂, E. P. Van Duzee. This subspecies may be distinguished from the others of the *macrogaster* complex by its laminate antennae, from which the name is derived. The subspecific name, *laminicornus*, is derived from the Latin words lamina, meaning "a thin plate," and cornu, "a horn."

16. *Acrolophus balduſi*, new species

FIGURES 90–94

MALE.—Head, labial palpi, and antennae whitish-ochreous. Labial palpi intermediate in length, recurved back over head and extending onto anterior margin of thorax, diverging rather strongly from head and from each other distad; clothed with very slender, elongate scales. Eyes rather small, sparsely and finely setose, heavily lashed and partially concealed by elongate setae. Antennae strongly unipectinate, covered dorsad with scales; segmental processes large, subcircular, platelike, finely ciliated, rather slender and broadly spaced from one another in lateral aspect. Thorax ochreous tinged with fuscous. Forewings with coloration somewhat variable, ground color grayish-white irregularly sprinkled with fuscous; brownish to fuscous markings in form of short bars along costa, narrow band sharply alternating between gray and brown along apical margin, spot at outer end of cell, and prominent fuscous patch in basal third on and beneath fold. Hindwings brownish, with margins and fringes alternately gray and brown. Legs and abdomen pale brown. Wing expanse: 18 to 22 mm.

FEMALE (association tentative).—General coloration similar to that of ♂ although slightly paler and with pattern less distinct. Labial palpi short, extending only slightly beyond antennal bases, closely appressed to head but well separated from each other, rather sparsely clothed with slender scales. Eyes similar to those of ♂ except less heavily lashed. Antennae simple, covered dorsad by scales, segments globose. Wing expanse: 26 mm.

MALE GENITALIA.—Vinculum atypical, considerably reduced; for most part appearing simply as rather weakly sclerotized, subcircular, ventral plate; areas of fusion with lateral arms of tegumen produced into pair of ventrolateral, subdigitate processes.

Tegumen glabrous, lateral arms very broad, dorsal area very broad and not separated along meson.

Harpe simple. Lateral aspect: major central portion very broad, lacking dorsal and ventral constrictions; costa and sacculus indistinctly fused, greatly reduced, comprising slightly more than basal quarter of harpe, glabrous, broadest in apical portion, approximate basal two-thirds markedly narrowed, basal extremity rather narrowly rounded; cucullus greatly enlarged, comprising slightly less than apical three-fourths of harpe, indistinctly fused with costa and sacculus, heavily punctate and setose ectad and entad except near base, broadest in apical half, dorsal margin weakly sinuate and curving slightly dorsad at base and apex, ventral margin sinuate and with central portion broadly expanded ventrad, approximate apical third strongly narrowing ventrad, apex narrow and directed dorsocaudad, apical extremity rather narrowly rounded.

Transtilla with arm rather long and slender, glabrous, major portion parallel with dorsal margin of costa, terminating subacutely slightly proximad of basal extremity of harpe.

Uncus bifid. Dorsal aspect: base partially separated from tegumen by narrow areas of reduced sclerotization, sparsely punctate; lateral margins heavily sclerotized, weakly sinuate, converging distad; angle of bifurcation rather narrow, rounded; furcae rather elongate and slender, tubular, well sclerotized, glabrous, basal portions rather closely subparallel, apical portions converging distad, major portions directed only slightly ventrad; apices curving strongly ventrad, approximate, acute.

Gnathos fused, in form of well sclerotized flap directed ventrocaudad, rather short and broad, dorsal surface finely but densely scobinate, apex broadly and evenly rounded.

Anellus membranous, unarmed, juxta absent.

Aedeagus rather small, shortened, subconical, asymmetrical, glabrous; in lateral aspect base with subtriangular, ventrocephalic expansion approximately two-thirds as large as remainder of aedeagus; major apical portion gradually tapering distad, apical third narrow and opening dorsad, apex narrowly and irregularly rounded.

Vesica small, membranous, unarmed.

TYPE.—Holotype ♂ (type no. 61440) in the U.S. National Museum.

PARATYPES (9 ♂♂).—Illinois State Natural History Survey (8 ♂♂); U.S. National Museum (1 ♂).

TYPE LOCALITY.—Douglas, Cochise Co., Ariz. (July 1–7, collector unknown).

DISTRIBUTION.—Southwestern United States. Arizona, New Mexico, and Texas.

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SPECIMENS EXAMINED.—11 (10 ♂♂, 1 ♀), from 4 localities:

ARIZONA: Douglas, Cochise Co., ♂ (July 1–7, collector unknown); Paradise, Cochise Co., ♂ (June, collector unknown). NEW MEXICO: Las Vegas, San Miguel Co., 8 ♂♂ (no date, Andreas Bolter collection). TEXAS: Locality and date unknown, ♀ ("Tex.," Andreas Bolter collection).

REMARKS.—This species undoubtedly ranges southward into Mexico. The single ♀ listed above has been only tentatively associated with *baldufi*. The latter is very closely related to the complex species *macrogaster*, the two comprising a rather unusual species group among the acrolophids, exhibiting great diversity in regard to cephalic structures. The labial palpi may be elongate or shortened, while the eyes may be naked or setose. Further, the antennae may be laminate, unipectinate, or bipectinate. However, the various members of the *macrogaster-baldufi* species group are bound together by their nearly identical genital structures. These include the distinctive combination of a bifid uncus and a fused gnathos. *Acrolophus baldufi* may be easily distinguished from its close relatives by its shortened labial palpi and strongly unipectinate antennae. Likewise, it may be separated from the remaining members of the genus by its characteristic harpe and aedeagus. The genital characters are consistent throughout my rather small series representing *baldufi*.

Acrolophus baldufi exhibits certain affinities with at least two Mexican species in this genus. At the U.S. National Museum there is a slide preparation of the ♂ genitalia of a specimen labeled "*Acrolophus echinon* Druce, Mexico City, Mexico, R. Müller #2075." The genitalia on this slide are quite similar to, although not identical with, those of *baldufi*. Also at the National Museum is a slide preparation of ♂ genitalia labeled "*Acrolophus barbipalpus* Busck, Paratype, Tehuacan, Mexico." The genitalia on this slide are somewhat similar to those of *baldufi*. However, the adults of *barbipalpus*, the type ♂ of which is also at the National Museum, and *baldufi* are externally quite distinct. This species is named in honor of Walter V. Balduf, Professor of Entomology at the University of Illinois.

17. *Acrolophus arisonellus* Walsingham

FIGURES 95–99

Acrolophus arisonellus Walsingham, 1887, Trans. Ent. Soc. London, p. 153, pl. 7, fig. 10, June.—Smith, 1891, List Lep. Bor. Amer., p. 94, no. 5053.—Dyar, 1900, Can. Ent., vol. 32, no. 10, pp. 308–309; 1903, List North Amer. Lep., p. 578, no. 6588.—Walsingham, 1915, Biol. Cent.-Amer., pt. 12, vol. 4, p. 391.—Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8174.—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 103, no. 9560.

Walsingham's original description follows:

Acrolophus arizonellus—*Palpi*, ♂, recurved, reaching beyond the middle of the thorax; ♀ short, slightly upturned, but scarcely reaching more than the length of the head beyond it. *Antennae* subochreous, rather flattened, simple, having a very slight notched appearance owing to the scales on the upper side being a little raised at the joints. *Head, thorax*, and *palpi* pale brownish, with a slightly hoary appearance from an admixture of grey hairs. *Fore wings* greyish brown, sprinkled with dark brown scales; the costal margin very narrowly subochreous, with about six pairs of ill-defined dark brown dots along it; a conspicuous dark brown spot at the end of the cell and another on the fold at one-third from the base; below this in one specimen is a pale patch; the fringes slightly paler than the wing, but mottled with brown; under side pale brownish, the margins narrowly greyish ochreous. *Hind wings* brown, with pale tips to the fringes; under side pale brownish. *Abdomen*: the long hairy clothing of the base of the abdomen above is pale greyish ochreous, the abdomen itself inclining to brown; lateral claspers elongate, spoon-shaped, curved inwards, tending to form a slight angle at their upper and outward extremity; the uncus double, with the two points very slightly diverging and not widely separated. *Exp. al.* ♂, 25 mm.; ♀, 36 mm.

I have a male and two females from Arizona, collected by the late Mr. Morrison.

Walsingham's illustrations of the ♂ genitalia consisted of the uncus and the cucullus of the harpe in lateral aspect and the uncus in dorsal aspect.

MALE GENITALIA.—Vinculum typical, as in other species.

Tegumen glabrous; lateral arm broad, narrowing toward point of articulation with vinculum; dorsal area broad, not separated along meson.

Harpe simple. Lateral aspect: rather elongate and slender, ventral margin abruptly and deeply emarginate near center to form constricted area of harpe; costa and sacculus indistinctly fused, comprising approximate basal half of harpe, glabrous, dorsal and ventral margins sinuate, broadest in apical third, approximate basal two-thirds abruptly narrowing immediately basad of point of attachment of arm of transtilla to less than half width of apical third, basal half gradually narrowing and curving somewhat dorsad toward rather narrowly rounded basal extremity, ventrocaudal extremity of sacculus prominently angulate; cucullus fairly well set off from costa and sacculus by dorsal and ventral constrictions near base, comprising apical half of harpe, sublinear, heavily punctate and setose except at base, dorsal margin sublinear but commonly becoming serrate toward apex, ventral margin smooth and expanding ventrad, base narrowed, broadest in apical third, apex narrowing ventrad.

Transtilla with arm large, elongate, of medium width, glabrous, rather widely subparallel with dorsal margin of costa, terminating subacutely somewhat distad of basal extremity of harpe.

Uncus bifid. Dorsal aspect: base with lateral areas heavily punctate, lateral margins weakly sinuate and converging distad; angle

of bifurcation subacute to narrowly rounded; furcae of medium length, rather robust, tubular, central portions weakly expanded in lateral aspect, sparsely setose, curving ventrad toward apices, rather closely subparallel; apices slightly divergent, directed ventrad, acute.

Gnathos typically paired, directed ventrocaudad; arms with apices overlapping, glabrous, subacute.

Anellus membranous, unarmed, juxta absent.

Aedeagus of medium length and width, asymmetrical, glabrous; base considerably expanded ventrad and partially opening dextrad, remainder sublinear; approximate basal half cylindrical, apical half opening broadly dextrad, apex narrowly rounded.

Vesica large, membranous, armed along dorsal and apical margins with row of approximately 10–15 cornuti; cornuti minute, acute, closely set, directed distad.

TYPE.—♂ and ♀ types in the British Museum (Natural History).

TYPE LOCALITY.—"Arizona."

DISTRIBUTION.—Southwestern United States. Arizona, New Mexico, and Texas.

SPECIMENS EXAMINED.—48 (41 ♂♂, 7 ♀♀), from 13 localities:

ARIZONA: Baboquivaria Mountains, 2 ♂♂ (no date, F. H. Snow); Huachuca Mountains, ♀ (July 20, 1936, J. N. Knull); McNary, White Mountains, 2 ♂♂ (July 10, 1936, A. B. Klots collection); Nogales, ♂ (Aug. 27, 1906, A. Koebele); Patagonia, 10 ♂♂, ♀ (July 18, 1948, C. & P. Vaurie); Pinal Co., "6 miles south of Florence," ♂ (July 23, 1924, E. P. Van Duzee); San Bernardino Ranch, Cochise Co., 3 ♂♂ (Aug., elevation 3750 feet, F. H. Snow); San Carlos, ♀ (July 11, 1936, "Parker, Lot 306," A. B. Klots collection); Tucson, 5 ♂♂, ♀ (St. Xavier National Monument, July 29, 1924, E. P. Van Duzee and J. O. Martin), ♂, ♀ (July 30, 1937, A. B. Klots), 3 ♂♂ (Oct. 8–10, 1939, Crandall), 2 ♂♂ (July 18 and 29, 1943, Fred H. Rindge collection); Tumacacori National Monument, Santa Cruz Co., 4 ♂♂, ♀ (July 20, 1948, C. & P. Vaurie). NEW MEXICO: State College, 5 ♂♂ (July 8, 1945), ♂ (July 26, 1945). TEXAS: Davis Mountain Junction, Reeves Co., ♂ (July 10, 1948, C. & P. Vaurie); Marathon, ♀ (July 9, 1948, C. & P. Vaurie).

REMARKS.—The material studied for this species was received on loan from six sources. The American Museum of Natural History furnished about half the specimens.

A. arizonellus, which undoubtedly ranges southward into Mexico, is very closely related to *luriei*, the two comprising a small species group. This group is related to those acrolophids having elongate labial palpi, setose eyes, bifid uncus, and paired gnathos. However, *luriei* and *arizonellus* may be distinguished from each other and from the other species treated here on the basis of their harpes and aedeagi. In *arizonellus*, the sacculus of the harpe is strongly angulated at its ventrocaudal extremity, a condition not exhibited by *luriei*. In

addition, the vesica of the aedeagus in *arizonellus* is armed with a single row of minute cornuti as compared with the unarmed vesica of *luriei*. The genital characters of *arizonellus* are quite consistent throughout my series of this species.

Among my specimens representing this species is an atypical ♂, collected along with a series of normal ♂♂ at Patagonia, Ariz., exhibiting abnormal or deformed genitalia. The moth itself is smaller and darker than the typical form and its forewings have a simpler or reduced color pattern. The genital capsule is approximately two-thirds as large as that of the typical form. The furcae of the uncus, although in themselves normally constructed, are widely separated by a very broadly and evenly rounded angle of bifurcation. This condition represents a marked divergence from the normal form of *arizonellus*. Although the harpes of the abnormal specimen are asymmetrical, they exhibit the characteristic angular condition at the ventrocaudal extremity of the sacculus. The left harpe is fairly typical, but the cucullus of the right harpe is unusually narrow, especially so distad, and its ventral margin becomes increasingly dentate distad. The vesica of the aedeagus is armed with only two cornuti, one several times larger than the other, situated near its apex. The cornuti are elongate, slender, and finely acute. Aside from being relatively smaller, the other genital structures, namely the vinculum, tegumen, gnathos, anellus, and aedeagus, seem to be fairly normal in form. To some extent, this atypical specimen represents a transitional form between *arizonellus* and *luriei*.

According to Carl Heinrich (1946, in litt.) the holotype of this species is in the U.S. National Museum. However, I could not locate a holotype for *arizonellus* at that institution in May of 1951. On the other hand, Mr. Tams of the British Museum (Natural History) has sent me photographs labeled "*arizonellus* Wals., type." These photographs show the adult ♂ and ♀ but only the genitalia of the latter. The adults pictured agree well with my specimens representing *arizonellus*. Although a photograph of the ♂ genitalia is not available, Walsingham's illustrations of the ♂ genitalia accompanying his original description of *arizonellus* reasonably confirm the identity of this species. The U.S. National Museum does have several slides of ♂ genitalia labeled "*arizonellus* Wlsm." These agree with my concept of this species.

Dyar (1900) listed the following distributional data for *arizonellus:* "Tucson, Arizona, July 19, 20 and 21 (E. A. Schwarz); Mesilla, New Mexico, June 25 and July 1 (T. D. A. Cockerell)."

18. *Acrolophus luriei*, new species

FIGURES 100–101

MALE.—Somewhat similar to *arizonellus* in general habitus. Head, labial palpi, and antennae luteous. Labial palpi elongate, recurved back over head and extending slightly beyond center of thorax, well clothed with scales but not plumose, basal portions closely appressed to head and to each other, apical portions weakly diverging from thorax and from each other distad. Eyes rather small, weakly protruding, heavily setose, weakly lashed. Antennae simple, laminate, covered dorsad with scales, segmental processes set closely together throughout antennae. Thorax ochreous tinged with black and white. Forewings rich brown sprinkled with bars and spots of darker brown; markings in form of short bars along apical half of costa, small dots along apical margin, large spot at outer end of cell, and diffused patch beneath center of fold; color pattern variable, commonly reduced or almost entirely wanting. Hindwings rich brown, fringes considerably paler. Legs ochreous. Abdomen dark brown. Wing expanse: 19 to 24 mm.

FEMALE.—General coloration similar to that of ♂, pattern variable as in ♂. Labial palpi short, basal portions appressed to head, apical portions strongly diverging from head. Eyes essentially same as those of ♂. Antennae simple, slender, segments completely encircled by scales. Wing expanse: 26 to 29 mm.

MALE GENITALIA.—Vinculum typical, as in other species.

Tegumen with lateral arm broad, glabrous, gradually narrowing toward point of articulation with vinculum; dorsal area fairly broad, not emarginate along meson, mesocaudal area very finely punctate and indistinctly fusing with base of uncus.

Harpe simple. Lateral aspect: linear, rather elongate and slender. Costa and sacculus fused, glabrous except for sparsely punctate and setose ventrocaudal margin of sacculus, apical half slightly and evenly expanded dorsad and ventrad, basal portion narrowing beneath point of attachment of arm of transtilla to approximately half width of apical portion, without angular formation at ventrocaudal extremity of sacculus. Cucullus rather indistinctly fused with costa and sacculus, comprising approximate apical half of harpe, linear or sublinear, heavily punctate ectad except for dorsal portion of basal two-thirds, base slightly narrowed, expanding slightly toward apex; apex broadly and evenly rounded, margin very finely dentate.

Transtilla with arm glabrous, well sclerotized, rather elongate, sublinear, slightly convergent with costal margin, less than one-third as long as harpe, terminating subacutely near basal extremity of harpe.

Uncus bifid. Dorsal aspect: base with lateral areas heavily punctate, lateral margins very heavily sclerotized and evenly converging caudad into furcae; angle of bifurcation acute, narrow. Furcae fairly robust, tubular, sparsely punctate, evenly curving caudoventrad, basal halves rather closely subparallel, apical halves somewhat divergent distad, apices acute.

Gnathos typically paired, directed mostly ventrad, arms glabrous, apices narrowly rounded and partially overlapping.

Anellus membranous, unarmed, juxta absent.

Aedeagus with length and width medium, approximately two-thirds as long as harpe, cylindrical, asymmetrical; basal fifth somewhat expanded, evenly curving ventrad, opening dorsad; remainder of aedeagus sublinear in all aspects, expanding slightly toward apex; apical half opening broadly dorsodextrad, terminating subacutely, armed with numerous extremely minute spinelike processes.

Vesica large, membranous, unarmed.

TYPE.—Holotype ♂ and allotype ♀ in the California Academy of Sciences.

PARATYPES (10 ♂♂, 1 ♀).—American Museum of Natural History (2 ♂♂); California Academy of Sciences (7 ♂♂, 1 ♀); U.S. National Museum (1 ♂).

TYPE LOCALITY.—Tucson, Pima Co., Ariz. (St. Xavier Monument, July 29, 1924, E. P. Van Duzee).

DISTRIBUTION.—Southwestern United States. Southern Arizona.

SPECIMENS EXAMINED.—15 (11 ♂♂, 4 ♀♀), from one locality:

ARIZONA: Tucson, 9 ♂♂, 4 ♀ ♀ (St. Xavier Monument, July 29, 1924, E. P. Van Duzee and J. O. Martin), ♂ (July 30, 1937, A. B. Klots), ♂ (July 30, 1943, Fred H. Rindge collection).

REMARKS.—This species undoubtedly ranges southward into Mexico. Of the four ♀ ♀ listed above, the allotype and paratype have been associated with the ♂♂ of *luriei* with reasonable certainty, the third ♀ is probably *luriei*, and the fourth possibly belongs to this species.

A. luriei is very closely related to *arizonellus*, the two comprising a small species group which has been characterized in the foregoing remarks on *arizonellus*. Both species are similar in general habitus and genital structure. In addition, a comparison of the locality records reveals that the two have been taken together at Tucson, Ariz., by various collectors. Of the two species, however, *luriei* is generally smaller and darker, its forewings exhibit a simpler or reduced color pattern, and its labial palpi are less heavily clothed with scales. In regard to genital structure, *luriei* differs from *arizonellus* in that the former lacks the angular formation at the ventrocaudal extremity of the sacculus of its harpe and that it also lacks cornuti in the vesica of its aedeagus. Aside from being somewhat smaller, the remaining

genital structures of *luriei*, namely the vinculum, tegumen, arm of the transtilla, uncus, gnathos, anellus, and aedeagus, are essentially the same as those of *arizonellus*. The genital characters of *luriei* are consistent among my examples of this species and they are distinct from those of all other acrolophids treated here. This species is named in memory of Pierre C. Lurie, formerly of Urbana and Chicago, Ill.

19. *Acrolophus maculifer* (Walsingham)

FIGURES 102–106

Eulepiste maculifer Walsingham, 1887, Trans. Ent. Soc. London, p. 143, pl. 7, figs. 1c, 1d, June.—Smith, 1891, List Lep. Bor. Amer., p. 94, no. 5045.—Dyar, 1900, Can. Ent., vol. 32, no. 10, p. 306; 1903, List North Amer. Lep., p. 577, no. 6580.

Acrolophus (*Eulepiste*) *maculifer* Busck, 1912, Rep. Laguna Marine Lab., vol. 1, p. 169.

Acrolophus maculifer Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8164.—Eyer, 1924, Ann. Ent. Soc. Amer., vol. 17, no. 3, p. 328, pl. 35, fig. 5.—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 103, no. 9550.

Walsingham's original description follows:

Eulepiste maculifer—Labial palpi, ♂, erect, the first joint thickly scaled beneath, the second and third joints without distinct tufts, brownish fuscous, paler on the inner sides and above. ♀ porrect, the first and second joints clothed with a coarse projecting tuft; the third joint only exposed, slender. *Antennæ* brownish, having a spotted appearance owing to thin lines of rather darker raised scales at the joints. *Head* brownish fuscous, tufted above the eyes. *Thorax and fore wings* brownish fuscous, the latter mottled with dark ferruginous and bearing a dingy white spot on the outer half of the fold and a more diffused and ill-defined patch of the same colour on the apical portion of the wing; there are some dull whitish markings in the cilia and before the anal angle; along the costa the brownish fuscous colouring is interrupted by paler and more greyish fuscous before and beyond the middle. *Hind wings* brownish. *Abdomen and hind legs* the same; tarsal joints spotted with fuscous; uncus slightly bent over, double, the points closely approximate; lateral claspers elongate, attenuated posteriorly, oblique at the ends, their upper extremity rather pointed. *Exp. al.* ♂, 20 mm; ♀, 20–24 mm.

Hab. Three males and two females from Arizona (Morrison).

Walsingham's illustrations consisted of (figure 1c) the head of the ♂ in lateral aspect and (figure 1d) the head of the ♀ in lateral aspect.

MALE GENITALIA.—Vinculum typical, as in other species.

Tegumen with lateral arm weakly constricted near center, narrowing strongly at point of articulation with vinculum, moderately punctate and setose; dorsal area rather narrow, almost completely separated along meson by deep cephalic emargination.

Harpe simple, sublinear. Lateral aspect: costa and sacculus reduced, slender, shortened, comprising approximate basal third of

harpe, indistinctly fused, glabrous except for setose and subdigitate ventrocaudal margin of sacculus, apical portion broadest and expanded somewhat ventrad, basal portion very slender, basal extremity narrowly rounded; cucullus set off from costa and sacculus by dorsal and ventral constrictions and area of reduced sclerotization, large, elongate, broad, heavily punctate and setose ectad and entad and especially so in apical third, apical portion narrowing distad and curving slightly dorsad, apex evenly rounded.

Transtilla with arm rather slender, of medium length, rather widely separated from and subparallel with dorsal margin of costa, glabrous, terminating acutely slightly distad of basal extremity of harpe.

Uncus simple, except at extreme apex. Dorsal aspect: base glabrous, with cephalic margin emarginate mesad; lateral margins heavily sclerotized, sublinear, gradually converging distad into uncal process. Uncal process indistinctly fused with base, concave beneath, gradually narrowing and curving ventrad toward apex; apex sparsely setose and moderately expanded into pair of minute, acute, heavily sclerotized, laterally flattened, divergent processes.

Gnathos fused, reduced, glabrous, well sclerotized especially along lateral margins, thickened dorsoventrad, directed ventrocaudad, apex narrow but evenly rounded.

Anellus large, elongate, membranous, unarmed, juxta absent.

Aedeagus elongate, slender, cylindrical, asymmetrical, nearly glabrous. Lateral aspect: basal two-thirds curving ventrad and caudad through angle of approximately 180° resulting in basal and apical portions of aedeagus pointing in almost same ventrocaudal direction, approximate basal sixth markedly and irregularly expanded ventrocaudad, apical third sublinear; small apical portion opening laterad and ventrad, directed somewhat ventrad, with dorsal half heavily sclerotized and with or without several minute spines, with ventral half weakly sclerotized and flattened, extreme apex acute.

Vesica rather short, slender, membranous, unarmed.

TYPE.—♂ and ♀ types in the British Museum (Natural History).

TYPE LOCALITY.—"Arizona."

DISTRIBUTION.—Southwestern United States. Arizona.

SOURCES OF MATERIAL.—American Museum of Natural History (5 ♂♂, 1 ♀); Cornell University (5 ♂♂); University of Kansas (4 ♂♂).

SPECIMENS EXAMINED.—15 (14 ♂♂, 1 ♀), from 5 localities:

ARIZONA: Baboquivari Mountains, 4 ♂♂ (no date, F. H. Snow); Fort Grant, 2 ♂♂ (Pinaleno Mountains, July 13–19, 1917, Cornell University Biological Expedition); Globe, ♂ ("Vicinity of Globe," Aug. 4–5, 1937, A. B. Klots); Superior, ♂ (Boyce Thompson Arboretum, Aug. 1, 1937, A. B. Klots); Tucson, 3 ♂♂ (July 22, 1917, collector unknown), 3 ♂♂, ♀ (July 30, 1937, A. B. Klots).

REMARKS.—This species undoubtedly ranges southward into Mexico, and is closely related to *cressoni* and *crescentellus*, with which it forms a distinct species group related to those acrolophids having short labial palpi, setose eyes, simple antennae, simple uncus, and fused gnathos. As characterized in the key, the *cressoni-maculifer-crescentellus* species group consists of small moths having eyes clothed with recumbent or recurved setae, rings of antennal scales widely separated and resembling small funnels, forewings with small patches of upraised scales, and a type of uncus consisting of a single process minutely and acutely bifid at the extreme apex. The vesica of the aedeagus is unarmed in these three species. *Acrolophus maculifer* may be distinguished from its close relatives, as well as from all other acrolophids treated here, by its characteristic harpe and aedeagus, the latter organ being very strongly recurved in this species. The genital characters of *maculifer* are consistent throughout my rather small series representing this insect.

Mr. Tams of the British Museum (Natural History) has sent photographs labeled "*maculifer* Wals., type" and showing the adult ♂ and ♀ and their respective genitalia which confirm the identity of this species.

20. *Acrolophus cressoni* (Walsingham)

FIGURES 107–109

Eulepiste cressoni Walsingham, 1882, Trans. Amer. Ent. Soc., vol. 10, p. 169, Nov.; 1887, Trans. Ent. Soc. London, p. 142.—Smith, 1891, List Lep. Bor. Amer., p. 94, no. 5044.—Dyar, 1900, Can. Ent., vol. 32, no. 10, p. 306; 1903, List North Amer. Lep., p. 577, no. 6579.—Walsingham, 1915, Biol. Cent.-Amer., pt. 12, vol. 4, pp. 377, 385.

Acrolophus (*Eulepiste*) *cressoni* Busck, 1910, Proc. Ent. Soc. Washington, vol. 11, no. 4, p. 187; 1912, Rep. Laguna Marine Lab., vol. 1, p. 169.

Acrolophus cressoni Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8160.—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 103, no. 9546.

Walsingham's original description follows:

Eulepiste cressoni—Palpi brown, with ochreous scales intermixed, the apical joint with an indistinct pale ochreous band around its middle. Antennae pale brown. Fore wings brown, with scattered purplish fuscous and ochreous scales, the former collected in raised tufts, especially about the dorsal margin; the latter aggregated in the form of three or four square patches, one before, and one beyond the middle of the dorsal margin, one about the middle of the costa and one at or just before the apex. These in some specimens are so arranged as to form an indistinct chess-board pattern, the dark and pale squares being alternate on the costal and dorsal halves of the wing; in some specimens the median costal and the antemedian dorsal pale squares, which are always somewhat the most conspicuous, are joined in an angulated fascia. Abdomen with the hind wings and their cilia dull brown. The first two pairs of legs conspicuously spotted with brown and ochreous, the third pair ochreous on the tibiae, spotted with brown on the tarsal joints. Expanse 15 to 20 millim., the ♀ being larger than the ♂.

Several specimens in the collection of the American Entomological Society of Philadelphia, from (Bosque County) Texas. I have long possessed and known this species, but could not believe it to be still undescribed, as it seems to be common in Texan collections; but I am unable to find any description agreeing with it. In coloration this seems to be almost inseparable from the preceding species (*simulatus*), but its short palpi and the neuration of the fore wings amply distinguish it, and probably do not justify the juxtaposition of the two species in systematic order. *Eulepiste*, indeed, exhibits some signs of affinity to the genus *Acrolepia*.

Walsingham (1887) later discussed this species in his revision and referred to his original description when he commented:

To this I may add that the thorax is crested posteriorly, the uncus double with the points abruptly bent over, very closely approximate, and laterally compressed or flattened; the lateral claspers of approximately even width throughout, the ends rather square, but slightly oblique.

MALE GENITALIA.—Vinculum typical, as in other species.

Tegumen similar to that of *maculifer;* lateral arm of medium width, narrowing at point of articulation with vinculum, punctate except in anterior and basal areas; dorsal area almost entirely divided along meson by triangular emargination, heavily punctate except near cephalic margin.

Harpe simple, somewhat variable, similar to that of *maculifer*. Lateral aspect: costa and sacculus fused, reduced, narrow, comprising approximate basal third of harpe; glabrous except for heavily punctate and setose, subdigitate, ventrocaudal margin of sacculus; basal third strongly narrowing to acute basal extremity. Cucullus distinct from costa and sacculus, large, elongate, rather broad, sublinear, not curving mesad; heavily punctate and setose, especially so on ental surface; dorsal and ventral margins sublinear to moderately sinuate, subparallel or gradually diverging distad to broadest area of harpe near apex; apex slightly narrowed, broadly and evenly rounded.

Transtilla with arm rather short, subparallel with to somewhat divergent from dorsal margin of costa, terminating subacutely distad of base of harpe.

Uncus simple, same as that of *maculifer*. Dorsal aspect: base glabrous, with cephalic margin emarginate mesad; lateral margins heavily sclerotized, sublinear, gradually converging distad into uncal process. Uncal process indistinctly fused with base, concave beneath, gradually narrowing and curving ventrad toward apex; apex sparsely setose and moderately expanded into pair of minute, acute, heavily sclerotized, laterally flattened, slightly divergent processes.

Gnathos fused, similar to that of *maculifer* although not identical; considerably reduced, heavily sclerotized, thickened dorsoventrad except in apical portion, curving ventrocaudad, glabrous, lateral

margins sublinear and gradually converging distad to narrow but evenly rounded apex.

Anellus membranous, unarmed; juxta absent, although upturned flap at base of aedeagus may be mistaken for one.

Aedeagus of medium length, slender, tubular, asymmetrical, subglabrous, approximately linear in dorsal and ventral aspects, sinuate and irregularly curving ventrad through angle of approximately 90° in lateral aspect, gradually and evenly narrowing distad from near base to near apex, ventral surface of base broadly and evenly expanded ventrad into flattened flap with apical half curving sharply through angle of 180° to rest against ventral surface of basal half (not to be mistaken for juxta); apex narrowing, subacute, with small dextral opening, with small ventral area minutely spinose.

Vesica small, membranous, unarmed.

TYPE.—Type ♂ in the British Museum (Natural History). Additional type material at the Academy of Natural Sciences of Philadelphia.

TYPE LOCALITY.—Bosque Co., Tex.

DISTRIBUTION.—Southern United States. Arizona eastward to Florida.

SOURCES OF MATERIAL.—American Museum of Natural History (2 ♂♂); California Academy of Sciences (1 ♂); Cornell University (1 ♂); Denison University (1 ♂, 2 ♀♀); Illinois State Natural History Survey (3 ♂♂, 1 ♀).

SPECIMENS EXAMINED.—11 (8 ♂♂, 3 ♀♀), from 5 localities:

ARIZONA: Boulder Springs, Mohave Co., ♂, ♀ (July 1–15, 1921, ♀ with three mites on eyes, O. C. Duffner); Hualapai Mountains, ♀ (July 15–30, 1921, two mites on wing, O. C. Duffner); Pinal Co., "14 miles east of Oracle," ♂ (July 24, 1924, E. P. Van Duzee). FLORIDA: Winter Park, ♂ (Sept. 1946, A. B. Klots). TEXAS: Basin, Big Bend National Park, Brewster Co., ♂ (July 5, 1948, C. & P. Vaurie); locality and date unknown, 3 ♂♂, ♀ ("Tex.," Andreas Bolter collection), ♂ ("Paratype," M. E. Murtfeldt collection, Cornell University).

REMARKS.—This species undoubtedly ranges southward into Mexico, with the specimen from Florida considerably darker than the others. *A. cressoni* is closely related to *maculifer* and *crescentellus*, with which it forms a distinct species group. This group has been characterized in the key and in the foregoing remarks on *maculifer*. All three species may be distinguished from one another, and from all other acrolophids treated here, on the basis of their harpes and aedeagi. In *cressoni*, the aedeagus is curved strongly ventrad and its base is expanded into a recurved process. The genital characters are consistent throughout my rather small series of this species.

Mr. Tams of the British Museum (Natural History) has sent photographs labeled "*cressoni* Wals., type" showing the adult ♂ and its genitalia. These photographs confirm the identity of this species.

In the U.S. National Museum there is a slide of ♂ genitalia labeled "*cressoni* Wlsm." Upon examination of this preparation, I found that it agreed with my concept of this species.

Darlington (in litt., 1946) has reported an additional type specimen of this species at the Academy of Natural Sciences as follows: "*cressoni* Wlsh. Type. Expanded and in fair condition, maculation distinct. There might be some question as to whether this is the type or only a paratype."

21. *Acrolophus crescentellus* (Kearfott)

FIGURES 110–111

Amydria crescentella Kearfott, 1907, Can. Ent., vol. 39, no. 1, p. 9, Jan.—Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 192, no. 8208.

Acrolophus (*Amydria*) *crescentella* Busck, 1910, Proc. Ent. Soc. Washington, vol. 11, no. 4, p. 187.

Myrmecozela crescentella McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 104, no. 9598.

Kearfott's original description follows:

Amydria crescentella—Expanse, 16 to 18 mm.

Palpi, head, antennae and thorax very pale brown, dusted with dark brown, the latter predominant on external surfaces of palpi. Abdomen and legs pale cinereous, tarsi dusted with brown.

Fore wing creamy white, slightly dusted with brown scales; this light ground colour only occurs in a large triangular basal patch, extending to a quarter on costa and nearly to middle on dorsal margin. A curved oblique fascia from middle of costa to end of cell, a similar but narrower fascia from costa just before apex, curving inwardly towards but not reaching the middle fascia. These two fascias are so sharply defined against the dark brown of the balance of the wing that they appear as a crescent-shaped band, interrupted in the middle.

The balance of the wing is cinnamon-brown, dotted with darker brown. In some specimens the pale basal area is rather heavily dusted with brown inwardly, leaving only the margin of the pale colour, forming a narrow oblique fascia. On the costa, within the crescent, are two pale dashes separated by a dark dot, and outwardly bounded by dark brown, which also extends below them. Before the middle of fascia the costa is cream colour, marked by a number of brown dots. On the outer margin is a line of dark brown dots, separated by a few paler scales. Cilia same as dark portion of wing.

Hind wing light cinnamon-brown, under side of both wings the same.

Five specimens, all Baboquivaria Mountains, Pima C., Arizona, July 15 to 30; two collected by Prof. F. H. Snow, three by Mr. O. C. Poling.

Types, University of Kansas and in my collection.

MALE GENITALIA.—Vinculum typical, as in other species.

Tegumen with lateral arm heavily punctate except in cephalic and basal areas, abruptly narrowing in basal third to point of articulation with vinculum, central third considerably expanded ventrad, apical third evenly narrowing dorsocaudad; dorsal area almost entirely divided along meson by cephalic emargination, mesal and caudal areas glabrous, laterocephalic areas punctate.

Harpe simple. Lateral aspect: similar to that of *cressoni*, but with basal half curving ventrad and apical half curving back dorsad equally as far. Costa and sacculus reduced, fused, comprising slightly more than basal third of harpe, glabrous except for heavily punctate and setose subdigitate ventrocaudal margin of sacculus, basal third very narrow. Cucullus only partly distinct from costa and sacculus, gradually curving mesad in apical half, large, elongate, rather broad, heavily punctate and setose (especially entad), dorsal and ventral margins subparallel, apical third slightly expanded, apex broadly and evenly rounded.

Transtilla with arm rather short, glabrous, slightly convergent with dorsal margin of costa, about one-sixth as long as harpe, terminating above base of harpe.

Uncus simple, similar to that of *cressoni*. Dorsal aspect: base glabrous, with cephalic margin emarginate mesad; lateral margins heavily sclerotized, sublinear, gradually converging into uncal process. Uncal process fused with basal area, slightly expanded before apex in dorsal aspect, gently curving ventrad to apex, sparsely punctate, apex minutely and acutely bifid as in *maculifer* and *cressoni*.

Gnathos fused, similar to that of *cressoni;* reduced, heavily sclerotized, glabrous, thickened dorsoventrad except in apical area, curving ventrocaudad, lateral margins sublinear and converging gradually to subacute apex.

Anellus membranous, glabrous, juxta absent.

Aedeagus rather short and slender, asymmetrical, glabrous, linear in dorsal and ventral aspect, basal and apical quarters curving gently ventrad in lateral aspect, basal quarter somewhat expanded laterad and broadly opening dorsad, apical three-fourths tubular and gradually narrowing to narrowly rounded apex, apical area with small dextral opening.

Vesica small, membranous, glabrous.

TYPE.—Three ♂ cotypes (type no. 61451) in the U.S. National Museum. Two additional cotypes presumably at the University of Kansas.

TYPE LOCALITY.—Baboquivari Mountains, Pima Co., Ariz.

DISTRIBUTION.—Southwestern United States. Southern Arizona.

SOURCE OF MATERIAL.—American Museum of Natural History (8 ♂♂, 1 ♀).

SPECIMENS EXAMINED.—9 (8 ♂♂, 1 ♀), from one locality:

ARIZONA: Tucson, Pima Co., 8 ♂♂, ♀ (July 30, 1937, A. B. Klots).

REMARKS.—This species undoubtedly ranges southward into Mexico. The specific name should be spelled *crescentellus* to agree grammatically with its present genus. It is closely related to *cressoni* and *maculifer*, with which it forms a distinct species group, which has been

characterized in the key and in the foregoing remarks on *maculifer*. All three species may be distinguished from one another, as well as from all other acrolophids treated here, on the basis of their harpes and aedeagi. The latter organ is of especial value in the separation of these three species which are otherwise so similar in regard to general habitus and genital structure. In *crescentellus*, the aedeagus is sublinear except at its basal and apical extremities. The genital characters are consistent throughout my rather small series of this species.

Kearfott originally described this species under the genus, *Amydria*, apparently not considering it to be an acrolophid. Busck (1910) properly transferred it to *Acrolophus* and said of it: "This species is nearest *Acrolophus* (*Eulepiste*) *cressoni* Walsingham." The three ♂ cotypes now in the U.S. National Museum have recently been assigned a type number during the course of this revision. They are labeled "*Amydria crescentella* Kearf." Two of these specimens are further labeled "Baboquivaria Mts., Pima Co., Arizona, July 15–30, 1903, Coll. O. C. Poling." The third specimen bears the label, "Baboquivaria Mts., Ariz., F. H. Snow." My examination of these cotypes found them to be identical and confirmed the identity of this species.

22. *Acrolophus piger* (Dyar)

FIGURES 112–117

Orthologhus piger Dyar, 1900, Can. Ent., vol. 32, no. 11, pp. 327–328, Nov.—Dyar, 1903, List North Amer. Lep., p. 579, no. 6597.

Acrolophus piger Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8189.—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 103, no. 9579.

Dyar's original description follows:

Orthologhus piger—Palpi erect, reaching above vertex, free from front, rather smoothly scaled. Fore wings light cinerous, slightly violaceous; an ochreous shade over centre of wing, limited inwardly by a black, mottled line from basal third of costa to above centre of inner margin, and outwardly by a similar line from below outer fourth of costa to opposite centre of outer margin, not reaching either margin. Between these lines the ochreous shade does not reach the costa, and is incised opposite the outer third of inner margin. Wing sparsely irrorate with black, distinctly along costa and in the ochreous shade. A group of dark scales on centre of outer margin. Hind wing blackish, pale along costal edge and extreme base. Expanse 17 mm. Male genitalia with uncus simple, gently curved, broadening toward base; harpes broadly rounded, spoon-shaped, strongly contracted at base, tips evenly rounded.

Three specimens; San Diego, Texas; May 24 to 26 (E. A. Schwarz); U.S. Nat. Mus., type No. 5348.

MALE GENITALIA.—Vinculum typical, as in other species.

Tegumen with lateral arm of medium width, narrowing to point of articulation with vinculum, cephalic margin sinuate, small punctate area along dorsocaudal margin; dorsal area rather broad, glabrous, cephalic margin broadly and evenly emarginate.

Harpe simple. Lateral aspect: sublinear, broadest in central area. Costa and sacculus fused, rather broad, comprising slightly more than basal half of harpe, dorsal margin quite heavily sclerotized, narrowing only slightly to base, glabrous except for heavily punctate and setose caudo-ental area markedly produced entad and dorsad and terminating subacutely. Cucullus partially set off from costa and sacculus by areas of reduced sclerotization, heavily punctate and setose in apical ental half, basal half mostly glabrous, apical half considerably expanded (especially ventrad) to give capitate appearance, apex broadly and evenly rounded.

Transtilla with arm typical; linear, glabrous, slightly convergent with costal margin, approximately one-fourth as long as harpe, terminating well above base of harpe.

Uncus distinctively bifid, although somewhat atypically and obscurely so. Dorsal aspect: mesal area occupied by elongate, narrow, triangular, caudal extension of tegumen; lateral areas sparsely punctate, regularly converging and narrowing to apices; angle of bifurcation extremely small and obscure; furcae pressed tightly together so as to appear fused, narrowing distad. Lateral aspect: basal portion extending caudad, gradually expanding ventrad at point of bifurcation; furcae less obscurely separate in this aspect, narrowing considerably toward apices; apices directed strongly ventrad and terminating very acutely, occasionally overlapping.

Gnathos paired; arms narrow, heavily sclerotized, overlapping so closely as to appear to be a single process, directed ventrad and slightly caudad, apical portions minutely scobinate, apices narrowly rounded.

Anellus membranous, glabrous, juxta absent.

Aedeagus of medium length and width, cylindrical, asymmetrical, glabrous, sublinear in dorsal and ventral aspects, basal fourth directed somewhat ventrad in lateral aspect; base slightly expanded and emarginate in ventral aspect, opening dorsad; apical third opening broadly dextrad.

Vesica membranous, dextral margin armed with indefinite row of 12 or more cornuti. Cornuti minute, weakly sclerotized, indistinct, unequal in size, with acute apices, directed caudad.

TYPE.—Type ♂ (type no. 5348) in the U.S. National Museum.

TYPE LOCALITY.—San Diego, Duval Co., Tex.

DISTRIBUTION.—Texas eastward to Florida.

SOURCE OF MATERIAL.—American Museum of Natural History (3 ♂♂, 1 ♀).

SPECIMENS EXAMINED.—4 (3 ♂♂, 1 ♀), from 2 localities:

FLORIDA: Lake Placid, ♀ (Archbold Biological Station, July 15–31, 1948, A. B. Klots); Winter Park, ♂ (June 1946, A. B. Klots), ♂ (July 1946, Klots), ♂ (Sept. 1946, Klots).

REMARKS.—This species undoubtedly ranges southward and westward into Mexico and is closely related to *vanduzeei*, the two comprising a small species group. The *piger-vanduzeei* species group consists of small moths having shortened labial palpi, eyes rather densely clothed with erect setae, simple antennae with segments encircled by rings of large scales, bifid uncus, and paired gnathos. The vesica of the aedeagus is armed with cornuti in these two species. *A. piger* may be distinguished from its close relative, as well as from all the other species treated here, by its characteristic harpe and aedeagus. In the latter structure, the armature of the vesica is quite distinctive for this species. Although *piger* superficially resembles *forbesi* in general habitus, the two are not closely related.

I have examined the type ♂ specimen at the U.S. National Museum. It is labeled "*Orthologhus piger* Dyar, type no. 5348, San Diego, Texas, May 26, 1895, Coll. E. A. Schwarz." Dr. Clarke removed the genitalia of the type for me and the identity of this species was thus further confirmed.

It is interesting to note that Dyar's type series of three ♂ specimens representing *piger* actually represents three entirely different species. The first specimen, set aside as the holotype or "type," properly represents *piger* as a valid species. The second specimen, set aside as a paratype or "cotype," is equivalent to my new species, *vanduzeei*. The third specimen, also designated as a paratype or "cotype," represents a third but already described species.

23. *Acrolophus vanduzeei*, new species

FIGURES 118–121

MALE.—Similar to *piger* in general habitus. Head luteous suffused with white. Labial palpi intermediate in length, recurved back over head and extending to anterior margin of thorax, weakly to strongly diverging from each other distad, moderately diverging from head distad, inner surfaces luteous but heavily fringed with white, outer surfaces ochreous suffused with fuscous, apical segments fuscous fringed with white. Eyes large, protruding, weakly lashed; rather densely clothed with short, erect setae. Antennae simple, luteous, each segment completely encircled by ring of large scales. Thorax luteous suffused with white. Forewings ashy-gray marked with brown and

fuscous; markings in form of brown spots along apical margin, fuscous spot at outer end of cell, and brownish patch covering basal third above fold; color pattern quite variable, commonly reduced to rich brown ground color with several diffused luteous patches. Hindwings and fringes brown. Abdomen grayish-brown; tip and apical portions of genitalia covered with elongate, slender, pale brownish scales. Wing expanse: 16 to 21 mm.

FEMALE.—Coloration generally similar to that of ♂, pattern of forewings not as variable as in ♂. Labial palpi somewhat shorter than in ♂, partially recurved over head and extending considerably above antennal bases, gradually diverging from head and from each other distad. Eyes similar to those of ♂ except less densely setose. Antennae slender, otherwise similar to those of ♂. Forewings grayish, speckled with dark brown or fuscous, with broad patch of grayish white extending along apical half of costa. Wing expanse: 24 to 27 mm.

MALE GENITALIA.—Vinculum typical, as in other species.

Tegumen with lateral arm elongate, slender, margins sublinear, evenly narrowing to point of articulation with vinculum, narrow punctate area near dorsocaudal margin; dorsal area of medium width, weakly sclerotized, glabrous, cephalic margin broadly emarginate.

Harpe simple, somewhat similar to that of *piger*. Lateral aspect: sublinear, broadest in central third of cucullus. Costa and sacculus fused, of medium width, comprising approximate basal half of harpe, dorsal margin heavily sclerotized, narrowing slightly to base, glabrous except for sparsely setose caudo-ental area weakly produced cephalodorsad and terminating subacutely. Cucullus partially set off from costa and sacculus by areas of reduced sclerotization, heavily punctate and setose in apical ental two-thirds, basal third mostly glabrous, dorsal margin sublinear, basal third rather narrow and slightly constricted, central third broadly and evenly expanded ventrad to almost three times width of narrowest portion of basal third, apical third gradually and evenly narrowing ventrad to broadly and evenly rounded apex.

Transtilla with arm typical; glabrous, slightly curved and convergent with costal margin, approximately one-fifth as long as harpe, terminating well above base of harpe.

Uncus bifid, essentially like that of *piger*. Dorsal aspect: base partially fused with caudal margin of tegumen, partially separated by areas of reduced sclerotization; mesal area weakly sclerotized, concave; lateral areas heavily sclerotized, punctate, evenly converging and narrowing to apices; angle of bifurcation small, very narrowly rounded; furcae narrowly separated at bases, strongly convergent with resultant marked overlapping of apical portions. Lateral aspect: basal and

apical areas narrowed, central area considerably expanded, apices directed caudoventrad and terminating acutely.

Gnathos paired, similar to that of *piger*; arms directed ventrad, lateral margins heavily sclerotized, apical portions scobinate and slightly overlapping, apices bluntly rounded.

Anellus membranous, glabrous, juxta absent.

Aedeagus of medium length and width, cylindrical, asymmetrical, glabrous, sublinear in dorsal and ventral aspects, approximate apical half curving gradually ventrad in lateral aspect, base somewhat expanded laterad, approximate apical three-fifths opening broadly ventrad; sinistral wall of aedeagus containing elongate, narrow, heavily sclerotized area extending almost to and becoming more distinct toward apex.

Vesica membranous, armed with approximately fifteen cornuti of various sizes, several very minute. Cornuti located mostly in perimeter of vesica and superficially appearing to belong to adjacent borders of aedeagus; arranged in form of incomplete oval along sinistral, ventral, dextral, and apical margins of vesica; well sclerotized, apices acute, two apical cornuti about twice as large as others and directed distad.

TYPE.—Holotype ♂ (type no. 61441) in the U.S. National Museum.

PARATYPES (6 ♂♂, 3 ♀♀).—California Academy of Sciences (1 ♂); U.S. National Museum (5 ♂♂, 3 ♀♀).

TYPE LOCALITY.—San Benito, Cameron Co., Tex. (Sept. 8–15, collector unknown).

DISTRIBUTION.—Southwestern United States. Texas westward to Arizona.

SPECIMENS EXAMINED.—10 (7 ♂♂, 3 ♀♀), from 5 localities:

ARIZONA: Baboquivari Mountains, Pima Co., ♀ (June 15–30, 1923, elevation approximately 5000 feet, O. C. Poling), 2 ♂♂, ♀ (Aug. 15–30, 1923, Poling), ♂, ♀ (July 15–30, 1924, Poling); Patagonia, Santa Cruz Co., ♂ (Aug. 2, 1924, E. P. Van Duzee). TEXAS: Brownsville, Cameron Co., ♂ (April 28, 1904, H. S. Barber); San Benito, Cameron Co., ♂ (Sept. 8–15, collector unknown); San Diego, Duval Co., ♂ (May 26, 1895, E. A. Schwarz).

REMARKS.—This species undoubtedly ranges southward into Mexico. It is closely related to *piger*, the two comprising a small species group. *A. vanduzeei* may be distinguished from its close relative, and from all the other acrolophids treated here, by its characteristic harpe and aedeagus. In the latter structure, the armature of the vesica is distinctive for this species. In other respects, *vanduzeei* is similar to *piger* on the basis of general habitus and genital structure; the similarity is especially noticeable in regard to their oddly shaped unci. This species is named in honor of the late Edward P. Van

Duzee. A number of the acrolophids collected by him have proved to represent new species.

24. *Acrolophus pseudohirsutus*, new name

FIGURES 122–124

Acrolophus hirsutus Busck, 1912, Proc. Ent. Soc. Washington, vol. 14, no. 3, p. 184, Sept. (preoccupied by Brazilian genotype, *Thysanoscelis hirsutus* Walsingham, 1887, Trans. Ent. Soc. London, pp. 145–146, pl. 7, figs. 3, 3a, 3b, 3c. The sinking of *Thysanoscelis* as a synonym of *Acrolophus* has resulted in the combination, *Acrolophus hirsutus* (Walsingham) 1887).—Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8162.—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 103, no. 9548. (New synonymy).

Eulepiste (?) *hirsutus* Barnes & McDunnough, 1913, Can. Ent., vol. 45, no. 12, p. 420.

Busck's original description follows:

Acrolophus hirsutus—Labial palpi as in the foregoing species (*diversus*), reaching vertex; ocherous, touched with dark brown. Head and thorax dark ocherous, mottled with black; thorax with short ocherous posterior tuft. Forewings ocherous, strongly suffused and mottled with dark brown and black; a faint series of terminal and costal dark dots, a black second discal spot, preceded and followed by a clear ocherous space, a short oblique plical spot, surrounded by light scales.

Hind wings dark brown with lighter base and a faint ocherous submarginal line. Abdomen dark brown above; anal tuft and under side ocherous.

Alar expanse, 20 to 22 mm.

Habitat: La Puerta Valley, California, June (Geo. H. Field, collector).

Type: No. 15123, U.S. Nat. Mus.; cotype in Mr. Field's collection.

MALE GENITALIA.—Vinculum typical, as in other species.

Tegumen typical, glabrous to minutely punctate; lateral arm elongate, slender, evenly narrowing toward point of articulation with vinculum; dorsal area narrow, with cephalic margin emarginate.

Harpe simple. Lateral aspect: costa and sacculus indistinctly fused, very large, broad, elongate, comprising basal three-fifths of harpe, apical portion moderately and evenly expanded ventrad, evenly narrowing to slender basal extremity, sparsely and minutely punctate, ventrocaudal margin of sacculus heavily punctate and setose. Cucullus separated from costa and sacculus by ventral constriction and area of reduced sclerotization, reduced, shortened, rather slender, sparsely punctate and setose ectad and entad, curving considerably ventrad toward apex, basal portion somewhat narrowed, apical portion somewhat expanded, broadest at or near apex, dorsal margin quite smooth although becoming moderately sinuate near apex, central portion of ventral margin roughly dentate; apex dentate, with 5–10 teeth varying in size and shape, ventral tooth commonly larger than others.

Transtilla with arm rather short, basal portion broad, sublinear, glabrous, weakly diverging from dorsal margin of costa toward subacute apex, failing to reach base of harpe by its own length.

Uncus simple. Dorsal aspect: base small, subtriangular, set off from tegumen by areas of reduced sclerotization, sparsely punctate and setose, laterobasal margins rounded, lateral margins converging into base of uncal process; uncal process indistinctly fused with base, rather elongate and slender, tubular, sparsely punctate and setose, curving slightly ventrad toward apex, gradually narrowing distad, apex acute.

Gnathos fused, rather elongate and slender, directed ventrocaudad, glabrous, somewhat thickened dorsoventrad, dorsal surface weakly concave, lateral margins well sclerotized and parallel, apex broadly and very evenly rounded.

Anellus large, membranous; densely clothed with minute, setalike processes; juxta absent.

Aedeagus elongate, slender, cylindrical, asymmetrical, glabrous, sublinear in dorsal and ventral aspects, basal fifth curving somewhat dorsad in lateral aspect, basal portion moderately expanded, apical portion opening dextrad, apex narrowly rounded.

Vesica rather small, membranous, basal portion narrowed; apical portion bulbous, armed with single cornutus; cornutus rather small, acute, directed distad.

TYPE.—Type ♂ (type no. 15123) in the U.S. National Museum.

TYPE LOCALITY.—La Puerta Valley, Calif.

DISTRIBUTION.—Western United States. California southward into Mexico.

SOURCES OF MATERIAL.—American Museum of Natural History (5 ♂♂); California Academy of Sciences (1 ♂); Carnegie Museum (3 ♂♂); Mr. Alex K. Wyatt, Chicago, Ill. (2 ♂♂).

SPECIMENS EXAMINED.—11 (all ♂♂), from 2 localities:

CALIFORNIA: La Puerta, 8 ♂♂ (July 1911, Wright & Field); La Puerta Valley, 2 ♂♂ (July 1911, Geo. H. Field). MEXICO: Angeles Bay, Gulf of California, ♂ (May 4, 1921, E. P. Van Duzee).

REMARKS.—The new name, *pseudohirsutus*, is here proposed to replace Busck's preoccupied name, *hirsutus*. This species is very closely related to *kearfotti*, the two comprising a small species group. The *kearfotti-pseudohirsutus* group consists of acrolophids having short labial palpi, naked eyes, simple antennae with segments encircled by rings of scales, simple uncus, and fused gnathos. These two species may be easily separated from all other species treated here, as well as from each other, by the structure of their harpes. They may also be distinguished from the other acrolophids, although not from each other, on the basis of their aedeagi. This great similarity of the

aedeagi could possibly be used as an argument for placing *pseudohirsutus* as a subspecies of *kearfotti*, a situation discussed in my remarks on the latter species. However, the two are retained here as distinct species. The characters furnished by the cucullus of the harpe in *pseudohirsutus* are both distinctive and consistent throughout my rather small series of this insect. The name, *pseudohirsutus*, has been coined from the Greek word, *pseudēs*, meaning "false," applied as a prefix to Busck's old name, *hirsutus*.

I have examined the type ♂ specimen at the U.S. National Museum. It is labeled "*Acrolophus hirsutus* Busck, type no. 15123, La Puerta Valley, Calif., July 1911, Geo. H. Field." The specimen readily confirms the identity of this species.

A. hirsutus, described by Busck in 1912, is still a valid species although its name is preoccupied and must be replaced.

In his revision of 1887, Walsingham erected a new genus, *Thysanoscelis*, designating as its genotype the new species, *T. hirsutus*, from Espirito Santo, Brazil. Following his description of *hirsutus*, Walsingham stated:

> I have two males of this curious species, purchased of Deyrolle in Paris many years ago. They obviously belong to the same group as *Acrolophus*, *Anaphora*, etc., but cannot, so far as I can determine, be rightly included in any hitherto described genus.

About the time Busck described his *hirsutus* from California, a general agreement was developing among the several active describers of acrolophids that most of the genera of the group should be combined and placed under the original genus, *Acrolophus*. Several years later, Walsingham (1915, pp. 375–380) found it necessary to place most of his previously described genera, including *Thysanoscelis*, into synonomy under *Acrolophus*. Thus, *Thysanoscelis hirsutus* became *Acrolophus hirsutus* (Walsingham), with the latter preoccupying *Acrolophus hirsutus* Busck.

Therefore, *hirsutus* Busck should be considered a new synonym of *pseudohirsutus*, the new name here proposed to replace Busck's preoccupied species name.

25. *Acrolophus kearfotti* (Dyar)

FIGURES 125–126

Eulepiste kearfotti Dyar, 1903, Can. Ent., vol. 35, no. 3, p. 76, March.

Acrolophus (*Eulepiste*) *kearfotti* Busck, 1910, Proc. Ent. Soc. Washington, vol. 11, no. 4, p. 186.

Acrolophus diversus Busck, 1912, Proc. Ent. Soc. Washington, vol. 14, no. 3, p. 134, Sept.—Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8158.—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 103, no. 9544. (New synonymy.)

Acrolophus kearfotti Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8166.—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 103, no. 9552.

Dyar's original description follows:

Eulepiste Kearfotti—Gray, with a reddish ochreous tint, brighter in an obscure streak beyond cell and on submedian fold. A series of black strigae along the costa and on fringe; a small dash beyond cell, and an oblique bar in submedian fold beyond middle. Hind wing blackish, fringe long, pale, interlined with blackish. Below, blackish, with a pale line at the base of the fringe. Expanse, 22 mm.

Two males from Mr. W. D. Kearfott's collection, "Yuma Co., Ariz. Desert."

Larger than the other species of *Eulepiste*, and differing in the genitalia. Uncus a single long spine, curving downward, opposed to a broad, concave basal plate. Side pieces strap-shaped or slightly concave, curved downward, and with a distinct spine on the lower angle.

U.S. National Museum, type No. 6734.

MALE GENITALIA.—Vinculum as in *pseudohirsutus*.

Tegumen as in *pseudohirsutus*, but commonly without emargination in cephalic margin of dorsal area.

Harpe simple. Lateral aspect: costa and sacculus as in *pseudohirsutus*, but with central and apical portions considerably broader.

Cucullus differing from that of *pseudohirsutus* in following respects: rather strongly constricted near base, widening distad of constriction, slightly narrowing again toward apex, dorsal margin with basal half sinuate, ventral margin without dentate area; apex narrowed, strongly emarginate; dorsal extremity of apex in form of subtriangular, acute or subacute projection; ventral extremity of apex in form of large, elongate, spinelike process curving rather strongly mesad toward apex and terminating acutely or subacutely.

Transtilla with arm more broadly divergent from dorsal margin of costa than in *pseudohirsutus*; quite variable, rather short and stout to fairly long and slender.

Uncus, gnathos, and anellus as in *pseudohirsutus*.

Aedeagus similar to that of *pseudohirsutus* except for basal portion: basal one-fifth to one-fourth more smoothly and evenly expanded, curving somewhat ventrad; with small ventral expansion distad of main basal expansion.

Vesica and cornutus as in *pseudohirsutus*.

TYPE.—Type ♂ (type no. 6734) in the U.S. National Museum.

TYPE LOCALITY.—"Yuma County, Arizona Desert."

DISTRIBUTION.—Southwestern United States. California eastward to Texas.

SOURCES OF MATERIAL.—American Museum of Natural History (8 ♂♂); California Academy of Sciences (1 ♂); Carnegie Museum (3 ♂♂); Cornell University (1 ♂); Mr. Alex K. Wyatt, Chicago, Ill. (1 ♂).

SPECIMENS EXAMINED.—14 (all ♂♂), from 5 localities:

CALIFORNIA: Jacumba, ♂ (Aug. 13, 1917, J. C. Bradley); Rancho La Sierra, Riverside Co., ♂ (Aug. 29, 1940, Fred H. Rindge collection), ♂ (Sept. 17, 1940, Rindge), ♂ (July 31, 1941, Rindge), ♂ (Aug. 7, 1941, Rindge), ♂ (July 9, 1942, three mites on abdomen, Rindge), ♂ (Aug. 16, 1942, Rindge), ♂ (July 17, 1947, Rindge); San Diego, ♂ (June 27, 1911, Geo. H. Field), ♂ (June 30, 1911, W. S. Wright), ♂ (July 1, 1911, Wright), ♂ (Aug., L. E. Ricksecker); Santa Paula, ♂ (July 31, 1923, H. H. Keifer). TEXAS: Boquillas, Brewster Co., ♂ (July 7, 1948, C. & P. Vaurie).

REMARKS.—This species undoubtedly ranges southward into Mexico. It has one synonym, *diversus* Busck, described from San Diego, Calif. *A. kearfotti* is very closely related to *pseudohirsutus*, the two comprising a small species group. This group has been characterized in the key and in the foregoing remarks on *pseudohirsutus*. These two species may be distinguished from the other acrolophids treated here on the basis of their harpes and aedeagi. However, the two may be distinguished from each other only by the differences occurring in the cuculli of their harpes. Except for this structure, the genitalia of both species are essentially the same. Their aedeagi are so similar that their distinctness as good species may be questioned. However, since the color patterns of the two moths are different and since *kearfotti* is at least half again as large as *pseudohirsutus*, they are retained here as distinct species.

I have examined the type ♂ specimen at the U.S. National Museum. It is labeled "*Eulepiste kearfotti* Dyar, type no. 6734, Desert, Yuma Co., Ariz." My examination of a slide preparation of the ♂ genitalia of the paratype, also from Yuma County, further confirmed the identity of this species.

Busck described *Acrolophus diversus* as a new species in 1912. Following his description, he stated:

> Alar expanse, 27 to 28 mm. Habitat: San Diego, California, July (Geo. H. Field, collector). Type: No. 15122, U.S. Nat. Mus.; cotype in Mr. Field's collection. Nearest in pattern and size as well as in the form of the palpi to *Acrolophus* (*Neolophus*) *persimplex* Dyar, from which it differs in the clearer color, more distinct pattern, and less hairy labial palpi.

Since 1912, *diversus* has appeared in the literature as a distinct species.

The type ♂, at the U.S. National Museum, is labeled "*Acrolophus diversus* Busck, type no. 15122, San Diego, Calif., 7/2/11, Geo. H. Field." After examining the type and a slide mount of the ♂ genitalia of a paratype, also from San Diego, I found them to be equivalent to Dyar's older species, *kearfotti*, the type ♂ of which is also at the U.S. National Museum.

Thus, *diversus* Busck should be considered a new synonym of *kearfotti* (Dyar). I fail to find any noticeable resemblance or relationship between Busck's *diversus* and *persimplex* (Dyar). Perhaps

Busck failed to compare *diversus* with the much more similar type of *kearfotti*, also presumably then available to him for study at the National Museum, because he felt that the latter species must be distinct as a result of its smaller wing expanse (22 mm.) and different type locality ("Yuma Co., Ariz. Desert").

26. *Acrolophus furcatus* (Walsingham)

FIGURES 127–131

Neolophus furcatus Walsingham, 1887, Trans. Ent. Soc. London, p. 141, pl. 7, figs. 1, 1a, 1b, June.—Smith, 1891, List Lep. Bor. Amer., p. 94, no. 5043.—Dyar, 1903, List North Amer. Lep., p. 577, no. 6577.—Walsingham, 1915, Biol. Centr.-Amer., pt. 12, vol. 4, p. 377.

Acrolophus furcatus Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8154.—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 103, no. 9540.

Walsingham's original description follows:

Neolophus furcatus—Labial palpi, ♂, slightly recurved, reaching to the back of the head; the apical joint roughly clothed with appressed scales, not brush-like. *Antennae* brownish ochreous, not serrated, although having that appearance at the tips, owing to the presence of raised scales. *Head*, *thorax*, and *palpi* dull greyish fuscous. *Fore wings* rather narrow, the costa almost straight, the apical margin oblique, scarcely convex; apical vein forked; greyish, sprinkled and striated around the margins with brownish fuscous; a broad irregular streak of brownish fuscous, from the base to the end of the cell, partly connected with two ill-defined spots of the same colour on the inner and outer thirds of the fold; fringes greyish fuscous. *Hind wings* pale greyish brown. *Abdomen* the same; lateral claspers narrow towards the base, rather triangular and upturned beyond it, obtusely rounded at the apex; uncus double, nearly straight, scarcely at all bent over, its opposing branch below being of nearly equal length with itself. *Exp. al.* ♂, 19 mm.

Hab. A single male from Arizona, collected by Morrison.

Walsingham's illustrations consisted of: figure 1, the adult ♂ in dorsal aspect (in color); figure 1a, the head of the ♂ in lateral aspect; and, figure 1b, the uncus, gnathos, and cucullus of the ♂ genitalia in lateral and dorsal aspects.

MALE GENITALIA.—Vinculum typical, as in other species.

Tegumen with lateral arm elongate, narrow, glabrous; dorsal area of medium width, glabrous, cephalic portion upraised, caudal margin irregular.

Harpe simple. Lateral aspect: sublinear, broadest in caudal portion of costa and sacculus. Costa and sacculus fused, broad in caudal portion, narrowing toward base, comprising approximate basal three-fifths of harpe, glabrous except for punctate and setose ventrocaudal margin of sacculus. Cucullus partially set off from costa and sacculus by areas of reduced sclerotization, very sparsely and weakly punctate and setose, margins smooth, dorsal margin

curving gradually and evenly dorsad to apex, basal third narrow and with margins subparallel, central portion evenly and broadly expanded ventrad to about twice width of basal third, apical portion narrowing considerably ventrad to apex; apex evenly and rather narrowly rounded, directed dorsocaudad and also curving mesad.

Transtilla with arm well sclerotized, glabrous, quite short, only about one-sixth as long as harpe, terminating acutely far above base of harpe, basal two-thirds diverging from costal margin of harpe, apical third converging toward costal margin.

Uncus bifid. Dorsal aspect: base separated from tegumen by irregular and roughened area of reduced sclerotization, cephalic margin deeply emarginate mesad, mesal area glabrous; lateral areas heavily sclerotized, sparsely punctate and setose, gradually converging distad and smoothly fusing into bases of furcae; angle of bifurcation very narrow, obscure; furcae approximate, superficially appearing as single process (especially in dried or untreated specimens), rather elongate and narrow, heavily sclerotized, directed caudad and slightly ventrad, lateral margins sparsely punctate and setose, apices acute and slightly divergent.

Gnathos fused, rather elongate, directed caudad and slightly ventrad, mesal portion weakly sclerotized, apical portion heavily scobinate; lateral margins heavily sclerotized, gradually and evenly converging to rounded and minutely emarginate apex.

Anellus large, membranous, unarmed, juxta absent.

Aedeagus very slender, elongate, approximately as long as harpe, extending back into abdomen, cylindrical, asymmetrical, glabrous, sublinear in dorsal and ventral aspects, approximate apical third to fourth sinuate and curving ventrad in lateral aspect; base expanded laterad and ventrad, emarginate ventrad, opening dorsad; apical fifth opening broadly and consisting simply of well sclerotized, narrow, dextral area terminating distad in short, acute, heavily sclerotized, spinelike process directed caudad.

Vesica membranous, apparently unarmed.

TYPE.—Type ♂ in the British Museum (Natural History).

TYPE LOCALITY.—"Arizona."

DISTRIBUTION.—Southwestern United States. Arizona.

SOURCES OF MATERIAL.—American Museum of Natural History (1 ♂, 1 ♀); California Academy of Sciences (2 ♂♂); University of Kansas (1 ♂).

SPECIMENS EXAMINED.—5 (4 ♂♂, 1 ♀), from 5 localities:

ARIZONA: Baboquivari Mountains, ♂ (no date, F. H. Snow); Dome, ♂ (July 21, 1924, E. P. Van Duzee); Maricopa Co., "10 miles north of Gila Bend," ♂ (July 22, 1924, with mites on abdomen, E. P. Van Duzee); Superior, Pinal Co., ♂ (Boyce Thompson Arboretum, Aug. 1, 1937, A. B. Klots); Tucson, Pima Co., ♀ (July 30, 1937, A. B. Klots).

REMARKS.—This species undoubtedly ranges southward into Mexico. It is generally related to *punctellus*, the two comprising a small species group. This group is related to those species having shortened labial palpi, naked eyes, simple antennae with segments encircled by rings of scales, and fused gnathos. In addition, the *furcatus-punctellus* species group is characterized by a type of obscurely bifid uncus in which the furcae are closely appressed and superficially appear simply as a single process with a median longitudinal suture. These two small species may be easily distinguished from one another, as well as from the other acrolophids treated here, on the basis of their harpes and aedeagi. The elongate genital capsule and especially the long, slender aedeagus of *A. furcatus* are somewhat similar to those of *variabilis*, but the genital and external characters of these two species are otherwise quite distinct.

Mr. Tams of the British Museum (Natural History) has sent photographs labeled "*furcatus* Wals., type" which show the adult ♂ and its genitalia. These photographs easily confirm the identity of this species.

27. *Acrolophus punctellus* (Busck)

FIGURES 132–134

Neolophus punctellus Busck, 1907, Proc. Ent. Soc. Washington, vol. 8, nos. 3–4, p. 99, Aug.

Acrolophus (*Neolophus*) *punctatus* Busck, 1910, Proc. Ent. Soc. Washington, vol. 11, no. 4, p. 187 (name misspelled).

Acrolophus punctellus Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8157.—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 103, no. 9543.

Busck's original description follows:

Neolophus punctellus—Antennae simple in both sexes, thick, with closely set whorls of short scales which give an appearance of serration; ochreous gray. Labial palpi in the males long, slightly recurved, reaching vertex, closely appressed to the face; in the females much shorter, porrected, terminal joint deflected. The palpi are slightly lighter than the head and thorax, which are covered with light fuscous white-tipped scales; thorax smooth. Fore wings appear pearly, light, whitish fuscous, irregularly and sparsely dotted with black scales; under a lens it is seen that the scales are of different shades of brown, each tipped with very light, nearly white, slate-color, except the few deep black ones, which are slightly metallic. Cilia blackish brown. Venation normal, with 12 veins, 7 to termen just below apex, 8 and 9 stalked, 1b furcate at base. Hind wings ochreous brown, with 8 veins, all separate; 3, 4, 5, 6, and 7 nearly equidistant and parallel from the end of the cell; a forked discal vein to vein 4 and to just below vein 6. Abdomen dark fuscous above. Under side of body whitish. Legs whitish, sprinkled with fuscous; tarsal joints dark brown, tipped with white.

Alar expanse, ♂, 19 mm.; ♀, 24 mm.

Hot Springs, Ariz., (E. A. Schwarz); Las Cruces, New Mexico (T. D. A. Cockerell).

Type.—No. 9905, U.S. National Museum.

A pretty species, which can not be confounded with any other American anaphorid, and is easily recognized by the pearly-black dusted fore wings.

MALE GENITALIA.—Vinculum rather small; typical, as in other species.

Tegumen with lateral arm broad, glabrous, gradually narrowing to point of articulation with vinculum, margins weakly sinuate; dorsal area broad, glabrous, cephalic margin slightly concave, caudal margin produced caudad to fill mesal emargination in base of uncus.

Harpe simple. Lateral aspect: slender, broadest in area of costa and sacculus giving rise to arm of transtilla. Costa and sacculus fused, narrowing slightly toward base, comprising approximate basal half of harpe, glabrous except for punctate and setose ventrocaudal margin of sacculus. Cucullus indistinctly fused with costa and sacculus, sublinear, directed somewhat ventrad, apical three-fourths sparsely punctate and setose (especially along ventral margin), margins sublinear and gradually diverging toward apex, broadest portion of apical area approximately twice width of narrowest portion of basal area; apex with ventral portion produced caudoventrad, ventral margin rather narrowly but evenly rounded, mesal margin broadly and weakly emarginate, dorsal margin very broadly and evenly rounded.

Transtilla with arm well sclerotized, glabrous, approximately one-fifth as long as harpe, widely separated from costal margin, terminating considerably above base of harpe.

Uncus very obscurely bifid. Dorsal aspect: base indistinctly separated from tegumen by narrow area of reduced sclerotization, cephalic margin broadly and deeply emarginate mesad, mesal area glabrous; lateral areas heavily sclerotized, punctate and setose, converging distad and fusing into bases of furcae; angle of bifurcation extremely acute and obscure, located slightly basad of midpoint of main uncal process; furcae of medium length, approximate, appearing as single process (especially in untreated specimens), heavily sclerotized, directed caudad and slightly ventrad, lateral margins punctate and setose, apices acute and approximate.

Gnathos fused, rather broad, directed caudoventrad, dorsal portion scobinate, lateral margins well sclerotized, converging slightly to broadly and evenly rounded apex.

Anellus membranous, unarmed, juxta absent.

Aedeagus of medium length and width, approximately four-fifths as long as harpe, cylindrical, asymmetrical, basal three-fourths sublinear in all aspects, apical fourth evenly curving ventrad, basal fourth broadly expanded laterad and terminating in pair of subdigitate lateral processes; apical third opening broadly ventrad and

consisting of several irregular, flattened, platelike, very weakly sclerotized, dorsolateral areas; dorsodextral area near apex armed with minute, acute, well sclerotized spine superficially appearing as cornutus of adjacent vesica; narrow area along dorsal margin of apical half of aedeagus armed with 8–10 extremely small and indistinct spines directed distad.

Vesica rather large, membranous, densely infolded, with subdigitate sinistral expansion. Portion of membrane within aedeagus armed with at least two cornuti: apical cornutus located just inside apical opening of aedeagus and embedded in membranous ventral pouch, rather elongate and slender, well sclerotized, apex acute, directed distad; basal cornutus located within basal half of aedeagus and embedded in membranes, larger than apical cornutus, well sclerotized, directed distad, otherwise indistinct because of its location.

This membrane enclosed within the aedeagus may represent the penis or perhaps a portion of the vesica retracted into the aedeagus. In the latter case, this might occur normally in the insect or it might have been caused inadvertently during the process of dissection. In any event, the flexibility of this membrane indicates that these cornuti could easily be extruded through the apical opening of the aedeagus during copulation, and thus appear as armature of the vesica.

TYPE.—Type ♂ (type no. 9905) in the U.S. National Museum.

TYPE LOCALITY.—Hot Springs, Ariz.

DISTRIBUTION.—Southwestern United States. Arizona, New Mexico, and (?) Texas.

SOURCES OF MATERIAL.—California Academy of Sciences (1 ♀); New Mexico College of Agriculture and Mechanic Arts (1 ♂).

SPECIMENS EXAMINED.—2 (1 ♂, 1 ♀), from 2 localities:

NEW MEXICO: State College, Dona Ana Co., ♂ (July 8, 1945, collector unknown); Busck, in his original description, also reported this species from Las Cruces, Dona Ana Co., New Mexico. TEXAS: Terlingua, Brewster Co., ♀ (May 6, 1927, J. O. Martin).

REMARKS.—This small species, apparently quite rare in collections, undoubtedly ranges southward into Mexico. The ♀ listed above has been only tentatively associated with the ♂ of *punctellus*.

A. punctellus is generally related to *furcatus*, the two comprising a small species group in which the relationship is not exceedingly close. These two species may be easily distinguished from each other, as well as from the other acrolophids here treated, by their distinctive harpes and aedeagi.

I have examined the type ♂ specimen at the U.S. National Museum. It is labeled "*Neolophus punctatus* Busck, type no. 9905, Hot Springs, Arizona, June 27." Its genitalia had been removed and mounted on

a slide by Busck on February 10, 1935. My examination of this preparation further confirmed the identity of this species.

28. *Acrolophus cockerelli* (Dyar)

FIGURES 139–143

Eulepiste cockerelli Dyar, 1900, Can. Ent., vol. 32, no. 10, p. 307, Oct.—Dyar, 1903, List North Amer. Lep., p. 577, no. 6581.

Acrolophus cockerelli Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8167.—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 103, no. 9553.

Dyar's original description follows:

Eulepiste Cockerelli.—Palpi upturned in front of the head, free, as high as the vertex; male antennae simple, slightly serrated toward the ends; veins 8 and 9 of fore wing stalked; thorax and fore wings dark brown-gray, somewhat grizzled or mottled with darker and with an obscure darker spot at the end of the cell. Hind wings dark brown; abdomen gray-brown; expanse 16 mm. One male, Mesilla Park, New Mexico, at light, July 8th (T. D. A. Cockerell); U.S. Nat. Mus., Type No. 4417.

Prior to the above description, Dyar said of the genitalia of *cockerelli*:

Uncus single, its opposing lower limb nearly as long as the upper and stouter. Harpes nearly flat, the ends bent inward, rounded.

MALE GENITALIA.—Vinculum typical, as in other species.

Tegumen glabrous; lateral arm elongate, slender, sinuate, narrowing to point of articulation with vinculum; dorsal area narrow, with mesal portion curving caudad.

Harpe simple. Lateral aspect: costa and sacculus fused, enlarged, broad, comprising approximate basal three-fifths of harpe, glabrous except for punctate and setose ventrocaudal margin of sacculus, broadest in apical third, evenly narrowing to narrow base. Cucullus rather indistinctly fused with costa and sacculus, rather short, broad, rectangular, comprising approximate apical two-fifths of harpe, directed considerably ventrad, not curved mesad, ectal surface subglabrous, ental surface punctate and setose, dorsal and ventral margins usually linear and parallel, apex truncate or nearly so.

Transtilla with arm of medium length, glabrous, sublinear, evenly narrowing to acute apex, diverging from margin of costa, failing to reach base of harpe by half to its own length.

Uncus simple, approximately same as those of *pseudohirsutus* and *kearfotti*. Dorsal aspect: base small, subtriangular, set off from tegumen by areas of reduced sclerotization, sparsely punctate and setose, laterobasal margins rounded, lateral margins converging distad into uncal process. Uncal process indistinctly fused with basal area, tubular, rather elongate and slender, sparsely punctate and setose, direc-

ted caudad and curving slightly ventrad, gradually narrowing distad to acute apex.

Gnathos fused, distinctive; elongate, flattened, directed caudoventrad, with mesal area of reduced sclerotization; lateral margins heavily sclerotized, linear, evenly converging distad to narrow but rounded apex; apex usually thickened dorsoventrad and armed at dorsolateral angles with pair of small, acute, dentate, somewhat divergent processes, each sometimes followed basad by 2–3 similar but smaller processes.

Anellus large, membranous, unarmed, juxta absent.

Aedeagus rather elongate, quite slender, cylindrical, subsymmetrical, glabrous, sublinear in all aspects, of almost constant width throughout except for moderately expanded base and slightly expanded apex, apical opening subcircular.

Vesica membranous, large, cylindrical, broader than and approximately as long as aedeagus, commonly spiriform, armed at extreme apex with single cornutus. Cornutus similar to that of *pyramellus*; basal half large, conical, moderately sclerotized, weakly costate, tapering distad; apical half quite slender, more heavily sclerotized, slightly curved, tapering to finely acute apex.

TYPE.—Type ♂ (type no. 4417) in the U.S. National Museum.

TYPE LOCALITY.—Mesilla Park, Dona Ana Co., N. Mex.

DISTRIBUTION.—Western United States. Utah, Arizona, New Mexico and Texas.

SOURCES OF MATERIAL.—American Museum of Natural History (3 ♂♂); California Academy of Sciences (11 ♂♂, 1 ♀); Carnegie Museum (1 ♂); Cornell University (2 ♂♂); Illinois State Natural History Survey (1 ♂); U.S. National Museum (1 ♂); University of Kansas (1 ♂).

SPECIMENS EXAMINED.—21 (20 ♂♂, 1 ♀), from 15 localities:

ARIZONA: Fort Grant, ♂ (Pinaleno Mountains, July 13–19, 1917, Cornell University Biological Expedition); Fort Huachuca, 2 ♂♂ (Aug. 3, 1924, J. O. Martin); Gila Bend, 4 ♂♂ (Aug. 20, 1924, E. P. Van Duzee and J. O. Martin); Huachuca Mountains, ♀ (Carr Canyon, Aug. 4, 1924, J. O. Martin); Paradise, Cochise Co., ♂ (July, O. C. Poling); Patagonia, ♂ (Aug. 2, 1924, E. P. Van Duzee); Pima Co., "30 miles east of Quijotoa," ♂ (Aug. 28–29, 1927); Pima Co., "16 miles south of Tucson," ♂ (Aug. 11, 1924, J. O. Martin); Pinal Co., "6 miles south of Florence," ♂ (July 23, 1924, E. P. Van Duzee); San Bernardino Ranch, Cochise Co., ♂ (Aug., elevation 3750 feet, F. H. Snow); Santa Catalina Mountains, ♂ (Aug. 13, 1924, gnathos atypical, E. P. Van Duzee), ♂ (Sabino Canyon, Aug. 13, 1924, gnathos atypical, Van Duzee), ♂ (Pepper Sauce Canyon, Aug. 16, 1924, Van Duzee); Superior, ♂ (Boyce Thompson Arboretum, Aug. 2, 1937, gnathos atypical, A. B. Klots). TEXAS: Locality and date unknown, ♂ ("Tex.," Andreas Bolter collection), ♂ ("Tex.," Henry Edwards collection). UTAH: Newton, ♂ (July 12, 1929, H. J. Pack).

REMARKS.—This species, named after T. D. A. Cockerell, undoubtedly ranges southward into Mexico. It is related to those species having short labial palpi, naked eyes, simple antennae with segments encircled by rings of scales, simple uncus, and fused gnathos. It is not closely related to any of the other acrolophids treated in this work, although it exhibits certain affinities with several species. The harpe of *cockerelli* is somewhat similar to those of *pseudohirsutus* and *kearfotti*, while its aedeagus is perhaps closest in appearance to that of *pyramellus*. However, *A. cockerelli* may be easily distinguished from its various congeners by its characteristic harpe, gnathos, and vesica. The genital characters of this species are consistent throughout my series representing it.

I have examined the type ♂ specimen at the U.S. National Museum. It is labeled "*Eulepiste cockerelli* Dyar, type no. 4417. (Acc. No. 34904). Mesilla Park, New Mexico, at light, July 8, Ckll." The specimen readily confirms the identity of this species. The characteristic spines of the gnathos are very well developed in the type specimen.

29. *Acrolophus pyramellus* (Barnes & McDunnough)

FIGURES 135–138

Eulepiste pyramellus Barnes & McDunnough, 1913, Can. Ent., vol. 45, no. 12, p. 420, pl. 16, fig. 4, Dec. (fig. cited should read "*Eulepiste pyramellus*, type ♂." It is incorrectly labeled *Eulepiste antonellus*).

Acrolophus pyramellus Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8163.—Eyer, 1924, Ann. Ent. Soc. Amer., vol. 17, no. 3, pl. 35, fig. 3. (mislabeled).—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 103, no. 9549.

The original description of Barnes & McDunnough follows:

Eulepiste pyramellus—♂.—Antennae annulate; palpi rather smooth, upturned to above front, but not appressed; front pale ochreous, thorax darker; primaries an admixture of pale gray and brown scales, maculation very indefinite and indistinct, in well-marked individuals consisting of a brownish blotch in cell near base, another at end of cell and a third midway between these two above inner margin, these latter are at times connected outwardly by a whitish oblique waved line which is usually more or less obsolete; indistinct costal and terminal dark dots; secondaries and underside unicolorous smoky brown. Expanse 23 mm.

Habitat: Pyramid Lake, Nevada. 4 ♂. Type, Coll. Barnes.

The species appears to be intermediate between *hirsutus* Bsk. and *occidens* Bsk.

MALE GENITALIA.—Vinculum typical, as in other species.

Tegumen glabrous; lateral arm elongate, very slender; dorsal area broad, not separated along meson.

Harpe simple. Lateral aspect: costa and sacculus indistinctly fused, broadest near point of attachment of arm of transtilla, gradually narrowing to base, basal extremity narrowly rounded, glabrous except for sparsely setose ventrocaudal margin of sacculus. Cucullus indis-

tinctly fused with costa and sacculus, comprising somewhat less than apical half of harpe, approximate apical two-thirds curving considerably ventrad, rather weakly constricted near base, approximate apical third markedly expanded ventrad, dorsal margin and apical third sparsely punctate and setose; apex with broad and shallow emargination, with dorsal extremity nearly squared to rather narrowly rounded, ventral extremity broadly rounded.

Transtilla with arm short, slender, glabrous, basal portion divergent from and apical portion parallel with dorsal margin of costa, apex acute, failing to reach basal extremity of harpe by approximately its own length.

Uncus simple. Dorsal aspect: base small, sparsely setose near lateral margins to entirely glabrous, completely and distinctly set off from tegumen by areas of reduced sclerotization, cephalic margin broadly and deeply emarginate mesad, lateral margins sinuate and converging distad into base of uncal process; uncal process elongate, slender, tubular, with lateral margins heavily sclerotized and sparsely setose, basal third curving somewhat ventrad, apical two-thirds linear, apex acute.

Gnathos fused into flattened flap directed ventrocaudad, elongate, of medium width, lateral margins heavily sclerotized and glabrous, mesal area weakly sclerotized and minutely pitted toward apex, apex broadly rounded.

Anellus large, membranous, unarmed, juxta absent.

Aedeagus elongate, slender, asymmetrical, cylindrical, glabrous, linear in dorsal and ventral aspects, approximate apical fourth curving considerably ventrad in lateral aspect, base irregularly expanded, apex weakly expanded and irregularly opening.

Vesica rather small, bulbous, membranous, armed at apex with prominent cornutus directed distad. Cornutus with basal portion large, moderately sclerotized, tapering distad; apical portion heavily sclerotized, tapering to acute apex.

TYPE.—Type ♂ (type no. 61452) in the U.S. National Museum.

TYPE LOCALITY.—Pyramid Lake, Nev.

DISTRIBUTION.—Western United States. Nevada, California, and Arizona southward into Mexico.

SOURCES OF MATERIAL.—American Museum of Natural History (5♂♂); California Academy of Sciences (2♂♂); Cornell University (23 ♂♂).

SPECIMENS EXAMINED.—30 (all ♂♂), from 6 localities:

ARIZONA: San Carlos, 21 ♂♂ (May 12–13, 1918, J. Ch. Bradley). CALIFORNIA: Palm Springs, Riverside Co., ♂ (April 26, 1944, Fred H. Rindge collection); Rancho La Sierra, Riverside Co., 3 ♂♂ (May 17 and 21, 1941, Fred H. Rindge collection), ♂ (May 16, 1947, Rindge collection); Victorville, 2 ♂♂ (April 30, 1918, J. Ch. Bradley); White Mountains, Inyo Co., ♂ (Silver Canyon,

May 11, 1926, J. O. Martin). MEXICO: Angeles Bay, Gulf of California, ♂ (May 4, 1921, abdomen and genitalia missing, E. P. Van Duzee).

REMARKS.—This species was presumably named after its type locality. *A. pyramellus* is related to those species having short labial palpi, naked eyes, simple antennae with segments encircled by rings of scales, simple uncus, and fused gnathos. It may be easily distinguished from the other members of the genus by its characteristic harpe and aedeagus. The genital characters of *pyramellus* are consistent throughout my series of thirty specimens.

I have examined the type ♂ specimen at the U.S. National Museum. It has recently been assigned a type number during the course of this revision. It is labeled "*Eulepiste pyramellus* B. & McD., Pyramid Lake, Nevada." This specimen exhibited a moderate amount of geographical variation in comparison to the material I had previously seen for this species. Dr. Clarke removed the genitalia of the type for me and the identity of *pyramellus* was thus confirmed. In addition, my examination of a slide preparation of the ♂ genitalia of a "cotype," also from Pyramid Lake, further confirmed the identity of this species.

Contrary to the brief comment accompanying the original description of this species, *pyramellus* is neither closely related to nor an intermediate between *hirsutus* (*pseudohirsutus*) and *occidens*. In the past, Busck and other workers have sometimes confused *pyramellus* with *kearfotti*.

30. *Acrolophus laticapitanus* (Walsingham)

FIGURES 144–149

A group of 69 male specimens, 59 from California and 10 from Arizona, presents a complex of four subspecies and one form. Involved in this complex are *laticapitanus*, *unistriganus*, *occidens*, *flavicomus*, and *leopardus*, all of which have been considered as distinct species up to the present time. There has been very little previous suggestion that any of these "species" are even closely related. Information received from the British Museum regarding *laticapitanus* and a study of the type material representing the other four "species" at the U.S. National Museum show that *unistriganus* is a synonym of *laticapitanus* and that *flavicomus* is a synonym of *occidens*. In addition, *leopardus* should be considered a form of *occidens*, since both occur in the same locality. Lastly, added to the complex are two subspecies, *heinrichi* and *clarkei*, described below as new.

The entire group is bound together by almost identical genital structure, except for the rather unstable cucullus of the harpe. Even the most specific organs, the aedeagus and its unarmed vesica (fig. 146), exhibit but little variation throughout the complex. The aedeagus may show some variation in respect to curvature and sinus-

tion in lateral aspect. If the aedeagus, vesica, or any of the other genital structures, except the cucullus, do possess usable characters for separation, they are too subtle for detection by the methods employed in this problem.

However, the variation found in the cucullus seems to exceed the limits of intraspecific variation observed in the other species of this family. Although the cucullus is somewhat unstable in any one series, its major variations enable one to separate the entire group into four fairly distinct series. Likewise, size, wing pattern, and ground color, although variable in some cases, enable one to divide the group into three rather definite series. The eyes are the same throughout the group and the labial palpi are of little value in the separation of series. However, the antennae aid in separating at least one series from the others. These differences in habitus and antennae also seem to exceed expected intraspecific variation. Using all of the above-mentioned differences, either singly or in combination, the entire complex may be separated into five reasonably distinct, although very closely related, series.

Geographical separation is responsible for most of the differences among these series, although it is not involved in the occurrence of two of the series in the same city. Thus, it is best to consider the material at hand as a complex composed of four subspecies and one form which offer rather poor characters for separation. Each of these subspecies exhibits variation or instability in one or more characters, and more information is needed, including larger collections over larger areas and studies of the immature forms and life histories, before this complex can be properly understood. Additional material may disclose better characters for separation, or it may show that geographical separation does not actually exist and that gradual and complete intergradation occurs between two or more of these subspecies.

The original group of 69 male specimens was divided into five series representing the four subspecies and one form now under consideration. The first series, consisting of 33 specimens from Oroville, California, agrees reasonably well with British Museum photographs of the type ♂ adult and genitalia of *laticapitanus* which was described from approximately the same area in northern California by Walsingham in 1884. In addition, this series agrees closely with Walsingham's original description of *laticapitanus*. The second series, 16 specimens from San Diego and Alpine, Calif., agrees with Busck's (1910) description of *occidens* from San Diego, approximately 550 miles south of Oroville. This series also agrees with the type material representing *occidens* in the U.S. National Museum. A third series, consisting of 10 specimens, also from San Diego, agrees reasonably

well with Busck's (1910) description of *leopardus* from that city, as well as with the type material representing *leopardus* in the U.S. National Museum. A fourth series, five specimens from Pinal and Pima Counties, Arizona, does not agree with the types of any of the previously described species. This series, described below as a new subspecies, *heinrichi*, agrees very closely with Dyar's (1903b) description of *unistriganus* from Coconino County, Arizona. However, Dyar's type material representing *unistriganus* has proved to be *laticapitanus*, thus extending the range of the latter 6–700 miles southeastward into north central Arizona. This places the type locality of *heinrichi* about 350 miles southeast of that of *occidens* and *leopardus* at San Diego, approximately 800 miles southeast of that of *laticapitanus* in northern California, but only about 200 miles south of the southernmost range known for *laticapitanus*. The fifth and last series, consisting of five specimens from Cochise County, Arizona, also does not agree with any previously described species. It is described below as a new subspecies, *clarkei*. Cochise Co. borders Pima Co. on the east and occupies the southeast corner of Arizona. Thus, the type locality of *clarkei* is fairly near that of *heinrichi*.

In all the members of this complex the eyes are large, protruding, devoid of setae and lashes, and offer no character for separation. The labial palpi are short, upcurved, and with the basal segment the largest. They are slightly longer in *occidens* and *leopardus*. The antennae are simple with the segments stout and closely set together. Each segment is furnished with one complete ring of scales as well as a second partial set on the dorsal surface giving each antenna a continuous, overlapping, dorsal covering of scales from base to apex. In *laticapitanus* each antennal segment bears two complete rings of scales, a character consistently enabling one to distinguish it from the other members of the complex. In regard to size, *occidens* is generally the largest of the group with a wing expanse ranging from 20 to 24 mm., although one dwarf specimen of less than 18 mm. easily intergrades in size with the other members. These are all quite small and range from 14 to 21 mm. in expanse.

The color patterns of all the members are given with reasonable accuracy and detail in the original descriptions (q.v.) and need no further elaboration here. In *laticapitanus*, *heinrichi*, and *clarkei* essentially the same, simple, consistent color pattern is exhibited. In *leopardus* the color pattern tends to be slightly more complex and variable. The *occidens* series exhibits the most complex and variable coloration, and its wing pattern permits it to be separated into at least two groups, the less frequent of which occurs in both Alpine and San Diego, California. In general habitus, *laticapitanus*, *heinrichi*, and *clarkei* resemble one another and are quite distinct from *occidens*

TABLE 2.—*Table for separation of laticapitanus complex.*

	laticapitanus	*occidens*	*leopardus*	*heinrichi*	*clarkei*
Range	Shasta, Lake, and Butte Cos., Calif. Coconino Co., Ariz.	San Diego and Orange Cos., Calif.	San Diego Co., Calif.	Pima and Pinal Cos., Ariz.	Cochise Co., Ariz.
Antenna	Each segment with two complete rings of scales.	Each segment with only one complete ring of scales.	Each segment with only one complete ring of scales.	Each segment with only one complete ring of scales.	Each segment with only one complete ring of scales.
Wing expanse	16–21 mm.	18–24 mm.	17–20 mm.	17–18 mm.	14–16 mm.
Color pattern (see original descriptions)	About same as that of *heinrichi* and *clarkei*. Stable.	Distinct from those of others, but quite variable.	Closest to that of *laticapitanus*, but fairly distinct. Rather variable.	About same as that of *laticapitanus* and *clarkei*. Stable.	About same as that of *laticapitanus* and *heinrichi*. Stable.
Ground color of wings	Pale yellow forewings contrasting with dark hindwings.	But little contrast between dark forewings and hindwings.	Grayish white forewings contrasting with dark hindwings.	Pale yellow forewings contrasting with dark hindwings.	Pale yellow forewings contrasting with dark hindwings.
Cucullus of harpe	First type (figs. 144, 145). Somewhat variable. Genitalia same as those of *occidens*.	First type (figs. 144, 145). Somewhat variable. Genitalia same as those of *laticapitanus*.	Second type (fig. 147). Fairly stable. Closely related to first type.	Third type (fig. 148). Somewhat variable, but quite distinct from all others.	Fourth type (fig. 149). Somewhat variable, but quite distinct from all others.

and *leopardus* in possessing pale yellow forewings contrasting with dark hindwings. In *leopardus* the grayish white ground color of the forewings contrasts with the dark hindwings. In *occidens* there is very little contrast in ground color between the forewings and hindwings, both of which are rather dark.

In regard to the genitalia, and specifically in regard to the form of the cucullus of the harpe, there are four variable types. The first type is exhibited by *laticapitanus* and *occidens* which have an identical genital structure (figs. 144, 145, 146). The cucullus is quite variable, differing as much within either of the two subspecies as it does between them. The second type of cucullus occurs in *leopardus* (fig. 147). Here, the shape of the cucullus is fairly stable, although it is obviously closely related to the first type. A third type, found in *heinrichi* (fig. 148), is quite distinctive and easily permits one to separate this subspecies from the others. In this case, the cucullus is unstable, varying in each of the five specimens on hand, although none of its variations approaches those found among the other subspecies. The fourth type of cucullus, exhibited by *clarkei* (fig. 149), is also distinctive but variable. In *heinrichi* and *clarkei* the cucullus shows a tendency toward the development of the dorsal portion of the apex, while in the other subspecies the cucullus exhibits a ventral development of the apex with a corresponding reduction or shortening of the dorsal portion.

The two members of this complex which may most likely intergrade are *occidens* and its form, *leopardus*. At least one specimen has the general size and color pattern of *occidens* but a cucullus shaped like that of *leopardus*. This would indicate that either the habitus, cucullus, or perhaps both tend to intergrade between these two. It is curious that Busck, who described both at the same time with one following the other on the same page, failed to indicate their close relationship. Instead, he related *occidens* to *kearfotti* (Dyar) and *leopardus* to *punctellus* (Busck).

Key to Subspecies of the *laticapitanus* Complex

(Based on Males)

1. Each antennal segment with two complete rings of scales.
30. laticapitanus (Walsingham)
Each antennal segment with only one complete ring of scales 2
2. Forewings grayish white or dark; cucullus of harpe of first (figs. 144, 145) or second (fig. 147) type, with dorsal portion of apex considerably reduced and ventral portion correspondingly produced distad 3
Forewings pale yellow; cucullus of harpe of third (fig. 148) or fourth (fig. 149) type, with dorsal portion of apex developed further distad than ventral portion 4

3. Larger, mostly 20–24 mm. in expanse; but little contrast in ground color between dark forewings and hindwings; cucullus of first type (figs. 144, 145), with ventral margin concave . . . . . **occidens** Busck
Smaller, 17–20 mm. in expanse; grayish white ground color of forewings contrasting with dark hindwings; cucullus of second type (fig. 147), with ventral margin convex . . . . . **occidens, form leopardus** Busck
4. Cucullus of third type (fig. 148), rather slender, sublinear, margins subparallel, apex subtruncate . . . . . **heinrichi,** new subspecies
Cucullus of fourth type (fig. 149), broadly and unevenly expanded, apex broadly and unevenly rounded . . . . . **clarkei,** new subspecies

30a. *Acrolophus laticapitanus laticapitanus* (Walsingham), new combination

Pseudoconchylis laticapitana Walsingham, 1884, Trans. Ent. Soc. London, p. 133, April.—Smith, 1891, List Lep. Bor. Amer., p. 90, no. 4770.—Dyar, 1903, List North Amer. Lep., p. 488, no. 5469.—Busck, 1907, Journ. New York Ent. Soc., vol. 15, no. 1, p. 20.—Walsingham, 1915, Biol. Centr.-Amer., pt. 12, vol. 4, p. 377.

Phalonia unistrigana Dyar, 1903, Proc. Ent. Soc. Washington, vol. 5, p. 232, Feb. (New synonymy.)

Pseudoconchylis (*Phalonia*) *unistrigana* Busck, 1907, Journ. New York Ent. Soc., vol. 15, no. 1, p. 20.

Acrolophus laticapitanus Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8176.—McDunnough, 1939, Check List Lep. Can. & U. S. Amer., p. 103, no. 9562.

Acrolophus unistriganus Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8178.—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 103, no. 9564.

Walsingham's original description of *laticapitanus* follows:

Pseudoconchylis laticapitana—Head whitish ochreous. Palpi the same, sprinkled with brownish scales externally. Antennae pale ochreous. Fore wings whitish ochreous, mottled and speckled with ochreous greyish brown and brown scales. Brown dots and spots are distributed around the costal and apical margins, the extreme base of the costa being also brownish. There is an ill-defined oblique fasciaform shade commencing below the outer third of the costal margin, and terminating in an aggregation of brown scales on the fold; the brown scales appear to be very fugitive, and in specimens only slightly worn are scarcely noticeable. Hind wings and abdomen pale brownish. Expanse, 17 mm.

Both sexes obtained in Lake County and Shasta County, California, June 25th to July 10th, 1871, by myself.

Male genitalia identical with those of *occidens*, described below.

REMARKS.—The type material, including the holotype ♂, is in the British Museum (Natural History). Mr. Tams has sent me photographs labeled "*laticapitanus* Wals., type," which show an adult ♂ and its genitalia. Both of these agree with a series of 33 ♂♂ received on loan from the California Academy of Sciences. These were collected by H. H. Keifer at Oroville, Butte Co., Calif., on the following

dates: June 20, 1925 (1 specimen); May 29, 1926 (24 specimens); June 25, 1927 (4 specimens); July 19, 1927 (4 specimens). Butte County is near Lake and Shasta Counties in northern California. I have not seen the ♀ of *laticapitanus*.

Walsingham placed his original description of *laticapitanus* directly beneath that of his new genus, *Pseudoconchylis*, and it is to be assumed that he intended the former to be the type species of the latter. It is interesting to note that he originally placed them in the Tortricidae, subfamily Conchylinae. In Dyar's list of 1903, they also appeared in the Tortricidae, but in the subfamily Phaloniinae. Busck (1907) stated: "*Pseudoconchylis* Walsingham does not belong in the Phaloniinae where it was originally placed and has since been retained in our lists. It is a genus of the Tineidae."

This subspecies has a synonym in *unistriganus* of which Dyar's original description follows:

Phalonia unistrigana—Wings elongate and rounded, palpi short. Ground color white, over-washed on the fore wings irregularly with faint ocherous, the white remaining in patches in and below cell, on internal margin and in a transverse band at outer third of wing. A narrow, broken, oblique black-brown line, directed from middle of inner margin to outer third of costa, not reaching inner margin, broken centrally, the lower part forming a rounded bar, the upper part more diffuse; a series of diffuse, irregular, dark dots in apical portion, in some specimens confined to apical margin, in others spread as far as tornus and situated on white ground color. Hind wing dark gray, fringe paler except at anal angle. Expanse, 18–22 mm.

Three ♀♀, June 9 (Williams, Arizona, Schwarz and Barber). Also a male from Flagstaff, Arizona. (Schwarz and Barber).

Type.—No. 6741, U.S. National Museum.

REMARKS.—After transferring *Pseudoconchylis* from the Tortricidae to the Tineidae, Busck (1907) stated:

Phalonia unistrigana Dyar is also a tineid and belongs to this genus. It is exceedingly close to if not identical with *laticapitana*, Walsingham; but considering the different localities it will be safer to retain it as distinct specifically until more material is at hand or the life history is worked out.

The specimens mentioned above by Dyar are at the U.S. National Museum. The holotype is a ♀ lacking both head and abdomen and thus can not be positively associated with any ♂ of the several subspecies of the *laticapitanus* complex. However, of Dyar's two remaining "♀ cotypes," one is actually a ♂. Its genitalia, removed and mounted on a slide by August Busck on Oct. 8, 1933, show it to be *laticapitanus*. Examination of the genitalia of Dyar's single ♂ from Flagstaff, Arizona, showed it to be *laticapitanus*, also. Both of these ♂♂ have the typical double ring of scales on each antennal segment. Several U.S. National Museum slides of ♂ genitalia labeled "*unistriganus*" also proved to be *laticapitanus*.

30b. *Acrolophus laticapitanus occidens* Busck, new combination

FIGURES 144–146

Acrolophus occidens Busck, 1910, Proc. Ent. Soc. Washington, vol. 11, no. 4, p. 186, Jan.; 1912, Rep. Laguna Marine Lab., vol. 1, p. 168.—Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8165.—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 103, no. 9551.

Acrolophus flavicomus Busck, 1912, Rep. Laguna Marine Lab., vol. 1, pp. 168–169, May.—Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8161.—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 103, no. 9547. (New synonymy.)

Eulepiste (?) *occidens* Barnes & McDunnough, 1913, Can. Ent., vol. 45, no. 12, p. 420.

Busck's original description of *occidens* follows:

Acrolophus occidens—Male.—Labial palpi curved, ascending, reaching vertex; first joint as long as second and third together, with evenly rounded brush; second joint also with a brush, continued slightly up over the equally long, smooth third joint. The form of the palpi is intermediate between those described for the genera *Eulepiste* and *Neolophus* Walsingham. The scales of palpi, head, and thorax are brownish fuscous tipped with white. Antennae ochreous fuscous. Fore wings grayish ochreous, overlaid with black, brown, and white scales. There is an oblique, ill-defined dark shade, edged with white, from apical fourth of costa to the middle of dorsum, nearly parallel with the terminal edge; on the apical fourth of the wing are four or five small black dots and outside of these the wing is strongly overlaid with white scales. Hind wings dark fuscous; abdomen dark fuscous, with white bands on the upper side. Legs ochreous, mottled with fuscous and with indistinct black tarsal annulations.

Alar expanse, 22 mm.

Habitat—San Diego, California. May. L. E. Ricksecker, coll. Additional specimens are in the collection of Mr. Kearfott.

Type—No. 12694, U.S. National Museum.

This species is very close in size, pattern, and form of the palpi to *Acrolophus* (*Eulepiste*) *kearfotti* Dyar, but is much paler, lacks the costal black spots, and has the clear cut oblique dash of *kearfotti* replaced by the less defined oblique fascia; the abundant white dusting, especially on the apical part, is also lacking in Dr. Dyar's species. All these color differences might, however, be individual in this group, where the color and markings are quite variable, but the claspers of the male genitalia are very different and the two species are undoubtedly amply distinct.

MALE GENITALIA.—Vinculum typical, but rather short.

Tegumen typical; glabrous to sparsely and weakly punctate, lateral arm narrowing slightly toward point of articulation with vinculum; dorsal area rather broad, unseparated, commonly with subtriangular caudal expansion filling mesal separation in base of uncus.

Harpe simple, somewhat variable, considerably constricted ventrad near center. Lateral aspect: costa and sacculus fused, sparsely and weakly punctate, comprising slightly more than basal half of harpe, broadest distad of center, narrowing somewhat toward rounded base; cucullus large, broad, with marked ventral constriction near base,

sparsely punctate and setose ectad and entad, curving gradually mesad toward apex, broadest distad of center, narrowing dorsad toward apex, apical portion curving somewhat ventrad and approximately half as broad as central portion, ventral margin emarginate and commonly sinuate, dorsal margin markedly expanded near center, apex evenly and rather broadly rounded.

Transtilla with arm of medium length and width, glabrous, subparallel with and rather broadly separated from dorsal margin of costa, terminating subacutely near base of harpe.

Uncus simple. Dorsal aspect: base reduced, separated along meson, separated from tegumen by areas of reduced sclerotization, sparsely punctate and setose, laterobasal margins rounded, lateral margins converging distad into uncal process; uncal process fused with base, elongate, tubular, slender, sparsely setose, curving slightly ventrad toward apex, gradually narrowing to acute apex.

Gnathos fused, rather elongate and narrow, directed ventrocaudad; dorsal surface concave, with apical third rugose; lateral margins parallel, well sclerotized; apex broadly and evenly rounded and with small, weakly sclerotized, ventral lobe or flap.

Anellus membranous, unarmed, juxta absent.

Aedeagus of medium length, rather slender, cylindrical, glabrous, asymmetrical, sublinear to weakly sinuate in all aspects, broadest in basal portion, gradually and evenly narrowing to central portion, center about half as wide as base, apical half of constant width; apex slightly expanded and with small, irregular opening.

Vesica small, membranous, unarmed.

REMARKS.—The holotype ♂ and a slide of the ♂ genitalia of a paratype were examined at the U.S. National Museum. In comparison to the material I had previously seen, the holotype exhibited a moderate amount of intraspecific variation in regard to the structure of the cucullus and the wing pattern, but there was no question as to its identity. I have seen only the ♂♂ of *occidens*. These include 16 specimens from San Diego County, Calif. One was taken at Alpine in July 1912 by Geo. H. Field, while the remaining 15 were collected in San Diego by Geo. H. Field and W. S. Wright on the following dates: May 2, 1908; May 6, 16, 22, and June 4, 1911; June 12 and 14, 1912; May 3 and June 4 and 14, 1913. Most of these dates of occurrence for *occidens* are earlier than those of its form, *leopardus*, discussed below. Since *occidens* exhibits essentially the same genitalia as, but is geographically separated from, *laticapitanus*, it should be considered a subspecies of the latter on the basis of the external differences described above.

This subspecies has a synonym in *flavicomus* of which Busck's original description is as follows:

Acrolophus flavicomus—Labial palpi curved, ascending, short, hardly reaching vertex; loosely tufted on first joint and in less degree on second and third joint; light ochreous; terminal joint dark brown above. Head and thorax ochreous brown. Forewings light, ochreous brown with two dark ill-defined streaks, forming an irregular cross; one from the middle of dorsum to costa just before apex; the other from tornus to basal fourth of costa; the latter is often more or less broken up and is easily partly lost in rubbed specimens. Still more easily lost and in fact only preserved in perfect specimens is a series of five undulating lines of white raised scales across the wing; on the fold in the central one of these white lines is an ill-defined black dot and the outer crossline contains two or three small patches of black scales before the terminal edge. Cilia light ochreous. Hindwings dark fuscous. Abdomen dark fuscous. Legs ochreous fuscous with faintly annulated tarsal joints.

Alar expanse, 19 mm.

Habitat—Laguna Beach, Southern California. C. F. Baker, coll. U.S. Nat. Mus. Type, No. 14337.

This species belongs to the group, described under the generic name *Eulepiste* Wlsm. and comes closest to *cressoni* Wlsm. and *maculifer* Wlsm., but is amply distinguished by the ornamentation. The various genera, erected in the family Acrolophidae on the secondary sexual characters of the labial palpi can not be maintained.

REMARKS.—The holotype ♂, from Orange Co., Calif., was examined at the U.S. National Museum where Dr. Clarke kindly removed its genitalia for me. It appears to be no more than a minor intraspecific variation of *occidens* from adjacent San Diego Co. The holotype has indications of two rings of scales on each antennal segment and in this respect approaches *laticapitanus*. Hence, *flavicomus* may be considered a partial intergrade between *occidens* and *laticapitanus* with genitalia similar to both, color pattern like the former, and antennae like the latter. Two ♂ paratypes, also collected by Baker at Laguna Beach, were borrowed from the U.S. National Museum for further examination. These also confirmed the sinking of *flavicomus* as a synonym of *occidens*. Contrary to Busck's comment, *flavicomus* does not belong to the *Eulepiste* group, for it is not at all closely related to Walsingham's species, *cressoni* and *maculifer*.

30c. *Acrolophus laticapitanus occidens* form *leopardus* Busck, new combination

FIGURE 147

Acrolophus leopardus Busck, 1910, Proc. Ent. Soc. Washington, vol. 11, no. 4, pp. 186–187, Jan.—Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8156.—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 103, no. 9542.

Busck's original description of *leopardus* follows:

Acrolophus leopardus—Labial palpi of the same form as in the preceding species (*occidens*); ochreous white, mottled with fuscous, especially exteriorly. Antennae light fuscous. Face and head white. Thorax ochreous white, sprinkled with fuscous. Patagina fuscous. Fore wings ochreous white, dotted with small blackish brown spots in rather regular transverse rows. Across the outer end of the cell is an interrupted, poorly defined blackish brown oblique streak, parallel with the terminal edge; on the apical part of the wing the dark spots are larger and arranged in rows between the apical veins. Hind wings dark fuscous. Abdomen dark fuscous. Legs ochreous, tarsi with black annulations.

Alar expanse, 17 to18 mm.

Habitat—San Diego, California. July. L. E. Ricksecker, coll.

Type—No. 12695, U.S. National Museum.

A small very distinct species nearest to *Acrolophus* (*Neolophus*) *punctatus* (= *punctellus*) Busck, lacking, however, the bluish-black dusting and differing also in the unmottled head and palpi and the spotted wing-pattern.

MALE GENITALIA.—Vinculum typical; consisting mostly of large, subtriangular, rather heavily sclerotized, ventral plate.

Tegumen as in *occidens*.

Harpe simple, slightly variable, considerably constricted ventrad near center. Costa and sacculus approximately as in *occidens*. Cucullus similar to but distinct from that of *occidens*; broadest near apex, gradually narrowing proximad to marked ventral constriction at base, dorsal margin very weakly concave, ventral margin moderately convex; apex subobliquely truncate, with margin weakly concave and sinuate, with dorsal angle nearly squared, with ventral extremity evenly rounded and extending considerably further caudad than dorsal angle.

Transtilla with arm similar to that of *occidens*, but shorter and considerably thicker.

Uncus similar to that of *occidens*, but with base largely fused with tegumen.

Gnathos similar to that of *occidens*, but with apex narrower and slightly upturned.

Anellus as in *occidens*.

Aedeagus similar to that of *occidens*; approximate basal fourth moderately expanded and curving somewhat dorsad, apical three-fourths of nearly constant width, apex deeply cleft.

Vesica as in *occidens*.

REMARKS.—The holotype ♂, collected on July 20, was studied at the U.S. National Museum, where its genitalia were removed for me by Dr. Clarke and its identity confirmed. A slide of ♂ genitalia labeled "*Acrolophus leopardus* Busck—San Diego, Calif.—A. Busck" was also examined at the U.S. National Museum. This further confirmed the identity of *leopardus*. I have not seen the ♀ of *leopardus* but I have ten ♂♂ from San Diego, San Diego Co., Calif., collected by

W. S. Wright on the following dates: June 19 and 22, 1909; June 30, July 1, 3, 24, 30, and August 21, 1911; July 3 (two specimens), 1913.

Busck described *leopardus* immediately after *occidens* in the same article. As it has been shown above, the two are not sufficiently distinct to be considered as separate species. Thus, since *leopardus* occurs in the same area as *occidens*, it should be considered as a form of the latter, rather than a direct subspecies of *laticapitanus*. Contrary to Busck's comment, a comparison of the genitalia indicates that *leopardus* is not especially closely related to *Acrolophus punctellus* (Busck).

30d. *Acrolophus laticapitanus heinrichi*, new subspecies

FIGURE 148

MALE.—Labial palpi ochreous, short, weakly recurved, diverging from head and from each other distad. Eyes large, protruding, without setae or lashes. Antennae simple; segments robust, subglobose, each furnished with one complete ring of ochreous scales. Head, thorax, and forewings pale yellow. Forewing with several, faint, minute, fuscous spots scattered in apical third. Hindwings and abdomen fuscous. Genitalia as in *laticapitanus* except for cucullus of harpe (fig. 148); cucullus somewhat variable but distinctive, only slightly constricted at base, major portion sublinear and rather slender, dorsal and ventral margins weakly sinuate and subparallel, apex subtruncate and with dorsal portion developed slightly to considerably further distad than ventral portion. Expanse: 17–18 mm.

FEMALE.—Labial palpi ochreous, slightly shorter than in ♂, porrect, closely subparallel. Eyes similar to those of ♂, but slightly smaller. Antennae simple; segments more elongate and slender than those of ♂, each almost completely covered by ring of scales. Coloration of head, thorax, wings, and abdomen same as in ♂. Expanse: 20–22 mm.

Holotype ♂, allotype ♀, paratype ♂ and ♀, U.S. National Museum, type no. 61442, all from Baboquivari Mountains, Pima County, Ariz. The holotype ♂ is labeled "Aug." The allotype ♀ has nine, variously sized, pale orange mites attached to its abdomen. In the paratype ♂, the labial palpi are very widely divergent and partially cover the eyes. These four specimens were found in the *laticapitanus* series at the U.S. National Museum. I am also designating as paratypes of *heinrichi* three ♂♂ received on loan from the American Museum of Natural History through the courtesy of Dr. Alexander B. Klots. These were collected by Dr. Klots at Boyce Thompson Arboretum, Superior, Pinal Co., Ariz., August 1–2, 1937. Dr. Klots' specimens agree remarkably well with Dyar's original description of *unistriganus* from Williams and Flagstaff, Coconino

Co., Ariz. However, as I have shown, *unistriganus* is a synonym of *laticapitanus*.

REMARKS.—This subspecies very closely resembles both *laticapitanus* and *clarkei* in general appearance and genital structure, but it may be distinguished from the former by its antennae, each segment of which bears only one complete ring of scales, and it may be separated from both by the shape of the cucullus of its harpe. This subspecies is named in honor of Carl Heinrich.

30e. *Acrolophus laticapitanus clarkei*, new subspecies

FIGURE 149

Female unknown.

MALE.—Labial palpi ochreous, short, weakly recurved, gradually diverging from head and from each other distad. Eyes large, protruding, without setae or lashes. Antennae simple; segments robust, subglobose, each furnished with one complete ring of ochreous scales. Head, thorax, and forewings pale yellow. Forewing with faint, irregular, fuscous, diagonal streak near center; apex and outer margin sparsely and minutely dotted with fuscous. Hindwings and abdomen fuscous. Genitalia as in *laticapitanus* except for cucullus of harpe (fig. 149); cucullus somewhat constricted at base, major portion considerably and irregularly expanded, apex very broad and with narrowly rounded dorsal portion developed further distad than broadly rounded ventral portion. Expanse: 14–16 mm.

Five ♂♂ from Paradise, Cochise Co., Ariz., June and August.

Holotype ♂, U.S. National Museum, type no. 61443, collected in August. Of the four ♂ paratypes, two are labeled "Aug.," one "Aug. 16–23," and one "June." One paratype has been retained by the author and the remaining type material has been returned to the U.S. National Museum.

REMARKS.—This subspecies bears a very close resemblance to both *laticapitanus* and *heinrichi* in regard to general appearance and genital structure. However, it may be distinguished from the former by its antennae, each segment of which bears only one complete ring of scales, and it may be separated from both by the shape of the cucullus of its harpe. This subspecies is named in honor of Dr. J. F. Gates Clarke.

31. *Acrolophus arcanellus* (Clemens)

FIGURES 150–157

Anaphora arcanella Clemens, 1859, Proc. Acad. Nat. Sci. Philadelphia, p. 261, Sept.; 1872, Tineina of North Amer., pp. vii, 57–58.—Grote, 1872, Can. Ent., vol. 4, no. 8, p. 143.—Chambers, 1878, Bull. U.S. Geol. & Geogr. Surv. Terr., vol. 4, no. 1, p. 128.—Holland, 1903, Moth Book, pl. 48, fig. 42 (mislabeled "*popeanella*").

Pseudanaphora arcanella Walsingham, 1887, Trans. Ent. Soc. London, pp. 170–171, pl. 8, fig. 25.—Beutenmüller, 1888, Ent. Amer., vol. 4, no. 2, p. 29.—Forbes, 1890, Sixteenth Rep. Ill., pp. 98–100, pl. 6, figs. 2, 3, 5.—Smith, 1891, List Lep. Bor. Amer., p. 95, no. 5066, p. 112.—Dyar, 1895, Can. Ent., vol. 27, no. 1, p. 15; 1900, Can. Ent., vol. 32, no. 10, pp. 310–311 (confused with "*mora* Grt."); 1903, List North Amer. Lep., p. 579, no. 6602; 1903, Can. Ent., vol. 35, no. 3, p. 76.—Forbes, 1905, Twenty-Third Rep. Ill., pp. 44, 95–98, fig. 77.—Walsingham, 1915, Biol. Centr.-Amer., pt. 12, vol. 4, pp. 378, 387.

Pseudoanaphora (*Anaphora*) *arcanella* Busck, 1903, Proc. Ent. Soc. Washington, vol. 5, p. 187.

Acrolophus arcanellus Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8192.—Forbes, 1923, Lep. New York, pp. 117, 120–121, figs. 87, 91, 93.—Comstock, 1924, Intro. to Ent., p. 611.—Eyer, 1924, Ann. Ent. Soc. Amer., vol. 17, no. 3, p. 315.—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 104, no. 9582.

Clemens' original description of *arcanellus* probably did not actually appear in print until sometime in 1860. It is quoted as follows:

Anaphora arcanella—Palpi luteous brown in front, dark brown externally. Thorax dark brown, almost blackish. Fore wings dark brown, with an obscure purplish hue; with luteous brown on the disc and in the fold, interrupted by a blackish brown, nearly square, submedian spot in the fold and a small one near its base of the same hue—sometimes merely a few blackish brown scales—with an irregular blackish brown spot on the end of the disc, and the costa and apical portion of the wing dusted and dotted, sometimes striated with blackish brown. Hind wings dark brown, tinged with blackish. Exp. al. 12 lines (about 25.5 mm.). Female not known.

Clemens mentioned elsewhere in his paper that the labial palpi of *arcanellus* were "ascending, but not recurved," due to the fact that they were shorter than those of the ♂♂ of *popeanellus* and *plumifrontellus*.

Walsingham (1887, p. 171) made the following comments on Clemens' original description of *arcanellus:*

To this may be added:—Antennae slightly serrated towards apex. Fore wings with 12 veins, all separate; apical vein not forked. Hind wings 8 veins, also separate, 7 and 8 parallel. Lateral claspers slender, widening slightly towards their posterior extremities, which are rather square. Uncus double, rather abruptly bent over, but not angulated, the points parallel, separated by about the width of one of them.

At the same time, Walsingham (1887, pl. 8, fig. 25) furnished several illustrations of the ♂ genitalia of this species. These consisted of the uncus in dorsal and lateral aspects and the cucullus of the harpe in lateral aspect.

Beutenmüller (1888) briefly described the ♀ of "*Pseudanaphora arcanella*" as follows:

The ♀ of this species, which has hitherto remained undescribed, differs from the male only in size, and short porrected labial palpi. Expanse of wings 32 mm. Length of palpi 1.50 mm.

MALE GENITALIA.—Vinculum typical, as in other species.

Tegumen with lateral arm of medium length and width, margins sublinear, strongly narrowing to point of articulation with vinculum; glabrous except for small, punctate, setose, dorsocaudal area; dorsal area broad, glabrous, not separated along meson, with mesocaudal expansion filling broad emargination in base of uncus.

Harpe simple. Lateral aspect: quite slender, approximate apical half directed considerably ventrad; costa and sacculus fused, comprising approximate basal half of harpe, glabrous except for heavily punctate and setose ental area of sacculus terminating subacutely ventrocaudad at base of cucullus, broadest in apical third at point of attachment of arm of transtilla, approximate basal two-thirds considerably narrower, basal extremity subacute; cucullus indistinctly separated from costa and sacculus by areas of reduced sclerotization, comprising apical half of harpe, directed considerably ventrad; approximate basal half very slender, very sparsely punctate and setose; apical half expanded ventrad, at least twice as broad as basal half, heavily punctate and setose ectad and entad, curving strongly mesad in dorsal and ventral aspects; apex broad, rounded.

Transtilla with arm of medium length and width, well sclerotized, glabrous, weakly sinuate, subparallel with dorsal margin of costa, terminating subacutely somewhat distad of basal extremity of harpe.

Uncus bifid. Dorsal aspect: base large, broad, largely set off from tegumen by areas of reduced sclerotization, punctate and setose except for glabrous mesal area; lateral margins well sclerotized, sinuate, rather weakly convergent distad; angle of bifurcation very broad, evenly rounded; furcae of medium length and width, tubular, punctate and setose, gradually narrowing and curving ventrad toward apices, broadly separated, major basal portions divergent, smaller apical portions slightly convergent, apices acute.

Gnathos typically paired, lateral margins and apical portions heavily sclerotized, directed mainly ventrad, apical portions curving somewhat caudad; arms broad, flattened, glabrous to weakly pitted, slightly divergent to strongly overlapping distad, apices very broadly and evenly rounded. In some specimens (fig. 150), combined outlines of uncus and gnathos in lateral aspect resemble semicircle; in others, uncus and gnathos are drawn close together and gnathos extends further caudad than uncus in dorsal and lateral aspects.

Anellus membranous, unarmed, juxta absent.

Aedeagus of medium length, five-eighths to three-fourths as long as harpe, markedly flattened dorsoventrad, broad in dorsal and ventral aspects, slender in lateral aspect, sublinear and asymmetrical in all aspects, glabrous, base unexpanded, approximate basal half tubular, apical half opening broadly dorsad and consisting only of

broad ventral wall; apex slightly narrowed, deeply and usually asymmetrically cleft.

Vesica large, membranous, consisting of several infolded layers, armed with single cornutus; cornutus large, elongate, rather slender, heavily sclerotized, linear, directed distad, base weakly and irregularly expanded, apex acute.

TYPE.—Type ♂ in the Academy of Natural Sciences of Philadelphia.

TYPE LOCALITY.—Not given by author, but presumably Philadelphia, Pa.

DISTRIBUTION.—Central and eastern United States. Nebraska and Texas eastward to New Hampshire and Florida.

SPECIMENS EXAMINED.—174, from 58 localities. The large number of specimens available for study has made it advisable to reduce the distributional data for this common species largely to the localities and months of occurrence:

CALIFORNIA: One ♂, from the American Museum of Natural History, labeled "Mariposa Grove, Calif., Aug. 11, 1916" (this record is very questionable). CONNECTICUT: East River (July); New Haven (June, July); Pleasant Valley (Oct.); South Meriden (July). FLORIDA: Biscayne Bay, Dade Co. (no date); Coral Gables (June); Florida City (March); Miami (Dec.); Orlando (Aug.); Royal Palm Park (Dec.). GEORGIA: Clarke Co. (June); Pomona (June). ILLINOIS: Algonquin (June, July, Aug., at light); Champaign-Urbana (June, July, Oct., both sexes common at light in June and July); Chicago (June); Edgebrook (June, July); Homer Park, Homer (June); McHenry (June); Oregon (July, at light); Palos Park (June and July, at light); Peoria (June, July, Sept., at light); Putnam Co. (June, July); Quincy (May); River Grove (June). INDIANA: Hessville (June and July, 1 ♂ with mites on eyes). IOWA: Des Moines (July). KANSAS: Lawrence (June). LOUISIANA: Alexandria (June); Opelousas (July). MASSACHUSETTS: Woods Hole (June). MISSOURI: Kirkwood (June); St. Louis (June). NEBRASKA: Lincoln (July). NEW HAMPSHIRE: Hampton (June, July). NEW JERSEY: Ramsey (July, Aug.); Union Co. (July); Wenonah (July). NEW YORK: Poughkeepsie (July); West Point (July). Long Island: Orient (Aug.); Prospect Park (July); Richmond Hill (July); Riverhead (June, Aug.). NORTH CAROLINA: Brevard (July); Hendersonville (July); Weaverville (Aug.). OHIO: Bellefontaine (July); Granville (July); Marion (July). PENNSYLVANIA: Allegheny Co. (no date); Butler (July); "Clarksval." (July); Finleyville (June); Hunters Run (July); Oak Station, Allegheny Co. (June); Pittsburgh (no date). TENNESSEE: Locality unknown, 2 ♀♀ (July 3, 1905, W. Osburn). TEXAS: Richmond (Brazos River, June).

REMARKS.—One of the first three acrolophids described from the United States, *arcanellus* is widely distributed throughout essentially the same area in which *plumifrontellus* occurs. It is also fairly common and somewhat variable in coloration. It is interesting to note that *arcanellus*, despite its age, wide range, abundance, and variability, has been described as new only once from America north of Mexico.

A. arcanellus is not especially closely related to any of the other species treated in this work. It may be characterized, as well as distinguished from the other members of the genus, by the following features: labial palpi of intermediate length, setose eyes, laminate antennae, bifid uncus, and paired gnathos. It is also unique in possessing a prominent tuft of lashes at the anterior margin of each eye. Lastly, the characters of its genitalia are quite distinct from those of its various relatives. The genital structure of *arcanellus* is reasonably consistent throughout my large series of this moth. In general appearance, this species is quite large and very robust.

I have not examined the type specimen of this species. Busck (1903), in his report on Clemens' types of Tineina deposited in the collection of the Academy of Natural Sciences in Philadelphia, tabulated the following information on this type:

Anaphora arcanella Clemens. One type, without abdomen but otherwise in good condition, Clemens' No. 12; alar exp., 29 mm. This species was transferred to the new genus *Pseudoanaphora* by Lord Walsingham. A specimen compared with the type is in the U.S. National Museum. Habitat: Eastern United States.

Darlington, in litt., 1946, has further confirmed the presence of this type at Philadelphia as follows: "*arcanella* Clem. Type. Only partially expanded, abdomen missing, maculation distinct, sex not determined." The combined information that I have been able to gather in regard to *arcanellus* leaves little doubt in my mind as to the proper identity and correct concept of this species. I have carefully checked the U.S. National Museum's series of specimens determined as *arcanellus* and found them to agree with my previous concept of this moth.

Dyar (1900, p. 311) published a paragraph of distributional data for *arcanellus*, listing it from New York, the District of Columbia, Missouri, and Texas.

32. *Acrolophus morus* (Grote)

FIGURES 158–161

Eutheca mora (♀) Grote, 1881, Bull. U.S. Geol. Geogr. Surv. Terr., vol. 6, no. 2, pp. 257–258, Sept.

Sapinella (*Eutheca*) *mora* Kirby, 1892, Syn. Cat. Lep. Het., vol. 1, p. 524, Genus 45, sp. no. 1.—Walsingham, 1915, Biol. Centr.-Amer., pt. 12, vol. 4, p. 378.

Pseudanaphora mora Dyar, 1895, Can. Ent., vol. 27, no. 1, p. 15.—Dyar, 1900, Can. Ent., vol. 32, no. 10, p. 310 (confused with "*arcanella* Clem.").—Merrick, 1901, Proc. Ent. Soc. Washington, vol. 5, no. 1, p. 40.—Dyar, 1903, List North Amer. Lep., p. 579, no. 6603; 1903, Can. Ent., vol. 35, no. 3, p. 76.

Acrolophus mora Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8195.—Forbes, 1923, Lep. New York, pp. 12, 120–121, fig. 94.—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 104, no. 9585.

Grote's original description follows:

Euthaca mora.—♀. I have several specimens of a Psychid (?) form which I cannot find in the books, and in collections the species is always unnamed. The antennae are simple, scaled. Eyes naked; ocelli wanting. Maxillae not perceivable. Labial palpi slight, hairy, ascending, curved. Body slender, sparsely haired. Legs rather stout and long; hind tibiae with two pairs of spurs. Fore wings elongate; costa arched; external margin oblique, even; internal margin rounded at base, retiring before internal angle. Veins 12, simple, cell divided; veins 2, 3, 4, equidistant from the end of median vein. Vein 1 furcate at base. Cell incompletely closed. Veins 5 and 6 nearly equidistant between 4 and 7; 7 from extremity of the vein dividing the cell; 8, 9, 10 near together from upper corner of cell, running to costa before apex; 11 out of subcostal vein very near the base; 12 free. Hind wings 8-veined; veins simple; the cell incompletely closed; vein 2 out of median vein at within outer third; veins tending to be equidistant. The fore wings are ochrey brown, with costal dots noticeable before apices. A pale ochrey shade on internal margin at base, extending upwardly in a triangular manner beyond the middle. This shading is not always defined. A curved discal streak. Hind wings brownish fuscous. Fringes on both wings a little darker; even, concolorous. Beneath much as above; costal region of secondaries ochrey brown. The hairy body parts concolorous fuscous brown; with paler hairs about the head and face. Expanse, 30 mil. Hab.—New York. I have not seen the male. This form has a curious resemblance to *Hepialus*, but the antennae are longer.

MALE GENITALIA.—Vinculum typical, as in other species.

Tegumen glabrous; lateral arm rather slender, weakly sinuate, narrowing to point of articulation with vinculum; dorsal area of medium width, not separated along meson.

Harpe simple. Lateral aspect: slender, approximate basal five-sevenths sublinear, apical two-sevenths curving noticeably ventrad, broadest slightly basad of center; costa and sacculus fused, reduced, rather slender, shortened, comprising approximate basal three-sevenths of harpe, glabrous except for sparsely punctate and setose ventrocaudal margin of sacculus, broadest in apical half, basal half strongly narrowed immediately basad of point of attachment of arm of transtilla, basal extremity subacute; cucullus indistinctly fused with costa and sacculus, comprising approximate apical four-sevenths of harpe; basal half broadest, slightly narrowing distad, sublinear, with dorsal margin sinuate, becoming sparsely punctate and setose distad; apical half slightly narrowed, with dorsal and ventral margins sublinear and subparallel, directed somewhat ventrad, becoming heavily punctate and setose distad especially on ental surface; apex bluntly rounded.

Transtilla with arm rather short, very slender, well sclerotized, glabrous, rather broadly separated from costa, gradually converging distad toward dorsal margin of costa, terminating acutely somewhat distad of basal extremity of harpe.

Uncus bifid. Dorsal aspect: base partially separated from tegumen by lateral areas of reduced sclerotization, rather sparsely punctate,

lateral margins well sclerotized and converging distad; angle of bifurcation broad, rounded; furcae of medium length, rather slender, tubular, converging and curving strongly ventrad toward apices, punctate and setose, basal portions broadly separated, apical portions rather narrowly separated, apices acute.

Gnathos typically paired, directed ventrad but with apical portions curving slightly caudad; arms rather slender, well sclerotized, with apical portions slightly divergent and finely scobinate entad, apices rather narrowly rounded.

Anellus membranous, unarmed, juxta absent.

Aedeagus large, approximately two-thirds as long as harpe, markedly flattened laterad, only about four times longer than broad, asymmetrical; base unexpanded, tubular; approximate apical two-thirds curving considerably ventrad, heavily sclerotized ventrolaterad, opening broadly dorsad; central portion of heavily sclerotized area armed with numerous, minute, acute, spinelike processes directed distad; apex narrowly rounded.

Vesica large, membranous, unarmed.

TYPE.—Type ♀ in the British Museum (Natural History).

TYPE LOCALITY.—"New York."

DISTRIBUTION.—Northern portions of central and eastern United States. Minnesota, Wisconsin, and Illinois eastward to New Hampshire, New Jersey, and North Carolina.

SPECIMENS EXAMINED.—68 (33 ♂♂, 35 ♀♀), from 24 localities (5 ♂♂ and 2 ♀♀ without data):

ILLINOIS: Chicago, ♀ (Oct. 18, 1904); "Northern Illinois," ♂, 3 ♀♀ (no date, Andreas Bolter collection). MASSACHUSETTS (?): ♀ labeled "Cambr. B.," possibly meaning Cambridge, Boston. MINNESOTA: Saint Anthony Park, Minneapolis (?), ♂ (Sept. 27, 1899), ♂, ♀ (Sept. 16, 1900); locality unknown, ♂ ("Minn.," date and collector unknown). NEW HAMPSHIRE: Hampton, ♀ (Oct. 11, 1904, S. Albert Shaw); Nashua, ♂ (Oct. 1900). NEW JERSEY: Alpine, ♀ (Oct. 1918, G. P. Engelhardt); Jamesburg, ♂ (Oct. 12, 1908); New Brunswick, ♀ (Oct. 1, J. A. Grossbeck collection), 2 ♂♂ (Oct. 5, Grossbeck collection); Palisades, ♀ (Oct. 11, 1917, G. P. Engelhardt); Riverton, ♂ (Nov. 5, 1905, Daecke collection); Wenonah, ♀ (Oct. 21, 1905, Daecke collection). NEW YORK: Brooklyn, Long Island, 2 ♀♀ (no date, G. P. Engelhardt); Horseheads, 2 ♀♀ (Oct. 17, 1935 and Oct. 23, 1940, L. R. Rupert); Ithaca, ♀ (Oct. 15, 1882, "Daytime"), ♂ (Oct. 5, 1934, Rehn), ♀ (Sept. 26, 1934, J. G. Franclemont), ♂, ♀ (Oct. 21, 1935, Franclemont), ♂ (Oct. 17, 1936, Franclemont); Yaphank, Long Island, ♂, ♀ (Oct. 12, 1915, G. P. Engelhardt); locality unknown, ♂, ♀ ("N.Y.," Henry Edwards collection). NORTH CAROLINA: Black Mountains, ♂ (1911). PENNSYLVANIA: Jeannette, ♂ (Oct. 11); New Brighton, ♀ (Oct. 26, 1902, H. D. Merrick), ♂ (Nov. 2, 1902, Merrick); Oak Station, Allegheny Co., ♀ (Oct. 8, 1908), ♂ (Oct. 18, 1908), ♂ (Oct. 1, 1911, Fred Marloff); Pittsburgh, ♀ (Sept. 12, 1905), 2 ♂♂ (Sept. 24 and 28, 1905), ♀ (Oct. 1, 1905, Henry Engel), ♂ (Oct. 2), ♂, 3 ♀♀ (Oct. 10); Rockville, 2 ♂♂, 3 ♀♀ (Oct. 13, 1912, E. Daecke), ♂ (Sept. 27, 1914); Roxboro, ♀ (Sept. 25, 1905); Swissvale, ♂, ♀ (Oct. 2), ♂ (date and collector unknown). WISCONSIN: Twin Lakes, ♀ (no date, Ramstadt).

REMARKS.—This species, the name of which should be spelled *morus* to agree grammatically with its present genus, is unusual in a number of respects. Of the various acrolophids occurring in America north of Mexico, it is the only valid species originally described entirely from the female. In regard to general distribution, it ranges further northward than any other acrolophid and it undoubtedly will be found to occur in southern Canada, especially in that portion of Ontario south of the forty-fifth parallel. Likewise, *morus* probably has the northernmost type locality of any acrolophid, and it regularly appears in the adult form considerably later in the year than any of its relatives. This species is also unique among the acrolophids found north of Mexico in exhibiting a pronounced sexual dimorphism in coloration. Lastly, the predominance of ♀♀ over ♂♂ in *morus* is quite unusual in collections of the various species of this group.

Some specimens of *morus* are abnormally small. A dwarf ♂ without data, furnished by Dr. C. E. Mickel of St. Paul, Minn., measures only 18 mm. in wing expanse. A small ♀ from Pittsburgh measures less than 24 mm. in expanse. A second ♀, received from the American Museum of Natural History, bears the following data: "From larva on birch. Imago Oct. 20, 1905. Laid eggs when pinned, loosely like Arctiinae (?). Egg white, long, narrow, strongly ridged."

Despite its age, fairly broad distribution, reasonable abundance, variation in size, and sexual dimorphism, *morus* has no synonyms. The material representing this species was received on loan from ten sources. The largest series were furnished by the American Museum of Natural History (6 ♂♂, 8 ♀♀) and the Carnegie Museum (7 ♂♂, 5 ♀♀).

A. morus is not closely related to any of the other acrolophids found in America north of Mexico. It may be characterized, as well as distinguished from the other members of the genus, by the following features: labial palpi of intermediate length, naked eyes, laminate antennae, bifid uncus, and paired gnathos. In addition, its general habitus and genital structure are quite distinct from those of its various relatives. The genital structure of *morus* is consistent throughout my series of this moth.

Mr. Tams of the British Museum (Natural History) has sent a photograph labeled "*mora* Grote, type ♀," showing the pinned adult in dorsal aspect, which unquestionably confirms the identity of this species, the ♀ exhibiting a very distinctive general habitus.

The taxonomic history of *morus* is interesting. Grote's single description represented both his new genus, *Eutheca*, and the latter's type species, *mora* (♀), also new. The generic name, *Eutheca*, was subsequently found to be homonymous with *Eutheca* Kiesenw. (1877, Coleoptera). In 1892, Kirby proposed the new name, *Sapinella*, to

replace Grote's *Eutheca*. Thus, the type of the genus became *Sapinella mora*. It is to be noted that Kirby, following Grote's suspicion, included this genus and species in the family Psychidae.

Dyar (1903, p. 76) discussed this species under the generic name, *Pseudanaphora*, as follows:

> In 1895 Lord Walsingham examined Grote's type in the British Museum, and thought it might be the female of *P. arcanella*, Clem., overlooking the description of the true female of this species by Beutenmüller (Ent. Amer. IV., 29, 1888). I have now before me ten females and eight males of *mora* from localities in New York, Pennsylvania and the District of Columbia, a majority of them taken by Mr. F. A. Merrick, at New Brighton, Pa. (see Proc. Ent. Soc., Wash., V. 40, 1902). There is a marked sexual dimorphism, the male being nearly uniformly blackish, and the female of a light ochreous ground colour. The species is very distinct from *arcanella*.

Thus, Grote (1881) originally described the species as a questionable psychid, Kirby (1892) gave it a new generic name and placed it in the Psychidae, Walsingham (1895) transferred it to the proper group (Anaphorinae) but confused it with an allied species, and finally Dyar (1903) proved its identity and distinctness along with a proper association of the sexes.

33. *Acrolophus forbesi*, new species

FIGURES 162–163

MALE.—Somewhat similar to *piger* in general habitus. Head, labial palpi, and thorax grayish white tinged with fuscous. Labial palpi intermediate in length, recurved back over head and extending to anterior margin of thorax, closely appressed to head and to each other, segmentation obscured by rather dense covering of coarse scales. Eyes large, protruding, rather sparsely furnished with very short setae, moderately lashed. Antennae simple, ochreous, covered dorsad with scales, densely clothed lateroventrad with minute setae, segmental processes robust and set closely together throughout antennae. Forewings grayish brown intricately sprinkled with fuscous, ochreous, and pale red; color pattern quite variable, commonly obscure or reduced. Hindwings and fringes dark brown. Abdomen brown, rather coarsely scaled. Cuculli of harpes with elongate tufts of slender scales. Wing expanse: 15 to 18 mm.

FEMALE.—Coloration similar to that of ♂, pattern variable as in ♂. Labial palpi slightly shorter than those of ♂, directed downward and slightly forward, rather narrowly separated from each other; clothed with elongate, slender scales. Eyes similar to those of ♂ except somewhat smaller. Antennae simple, slender, entirely covered by scales. Forewing commonly grayish-brown with four or five large, grayish white patches; pattern variable, commonly obscure or reduced. Wing expanse: 21 to 24 mm.

MALE GENITALIA.—Vinculum typical, but quite small.

Tegumen glabrous; lateral arm of medium width, narrowing toward base; dorsal area narrowing mesad, with mesal portion curving caudad and filling emargination in base of uncus.

Harpe simple, sublinear and with approximate basal three-fourths very slender in lateral aspect. Costa and sacculus fused, greatly reduced, very narrow, comprising approximate basal three-eighths of harpe, glabrous except for sparsely punctate and setose ventrocaudal margin of sacculus, narrowing slightly to base. Cucullus indistinctly fused with costa and sacculus, elongate, considerably enlarged distad, comprising approximate apical five-eighths of harpe, markedly capitate in lateral aspect, directed slightly ventrad; heavily punctate and setose (especially so distad and on ental surface); apical half directed somewhat mesad, basal third very narrow, central third expanding distad, apical third broadly and evenly expanded and rounded.

Transtilla with arm typical; slightly sinuate, glabrous, terminating subacutely distad of base of harpe.

Uncus simple. Dorsal aspect: base broad, subtriangular, laterobasal angles set off from tegumen, punctate except for glabrous mesal area and lateral margins, lateral margins converging into uncal process. Uncal process fused with basal area, tubular, rather short and stout, sparsely punctate and setose dorsad at base, evenly curving caudoventrad, narrowing to acute apex.

Gnathos fused, moderately sclerotized, glabrous, flattened, directed ventrocaudad, of medium length and width, lateral margins sublinear and subparallel, apex broadly and evenly rounded.

Anellus membranous, unarmed, juxta absent.

Aedeagus short, stout, glabrous, asymmetrical, sublinear in dorsal and ventral aspects, basal and apical portions curving somewhat ventrad in lateral aspect, base unexpanded, basal half cylindrical and of constant width, apical half opening broadly dorsad and consisting of well sclerotized ventral strip evenly narrowing distad to acute apex.

Vesica membranous, of medium size, bulbous, armed dorsad with approximately 15–20 cornuti. Cornuti quite small but distinct, mostly uniform in size, well sclerotized, acute, chiefly located in single row extending along meson or in two parallel rows bordering mesal area of vesica, usually directed distad or nearly so.

TYPE.—Holotype ♂ and allotype ♀ (type no. 61444) in the U.S. National Museum.

PARATYPES (25 ♂♂, 5 ♀♀).—American Museum of Natural History (5 ♂♂, 3 ♀♀); Cornell University (9 ♂♂); U.S. National Museum (3 ♂♂, 1 ♀); Mr. Alex K. Wyatt, Chicago, Ill. (8 ♂♂, 1 ♀).

TYPE LOCALITY.—St. Petersburg, Pinellas Co., Fla. (allotype taken in July, collector unknown).

DISTRIBUTION.—Southeastern United States. Florida, Georgia, and North Carolina.

SPECIMENS EXAMINED.—32 (26 ♂♂, 6 ♀♀), from 7 localities:

FLORIDA: Gainesville, Alachua Co., ♂ (June 3, 1927, traplight, J. S. Rogers), 7 ♂♂ (July 10, 1927, traplight, Rogers); Lake Placid, Highlands Co., 2 ♂♂ (Archbold Biological Station, July 15-31, 1948, A. B. Klots); St. Petersburg, Pinellas Co., ♂ (June 14, 1914, R. Ludwig), ♀ (June 30, 1914, Ludwig), ♀ (July, collector unknown), 3 ♂♂ (date and collector unknown); Winter Park, Orange Co., ♂, 2 ♀♀ (June 1946, A. B. Klots), ♂, ♀ (July 1946, Klots). GEORGIA: Groveland, Bryan Co., ♂ (Cannoche River, July 28, 1913, J. C. Bradley); Screven Co., 8 ♂♂, ♀ (July 10, 1946, A. K. Wyatt). NORTH CAROLINA: Maxton, Robeson Co., ♂ (no date, A. B. Klots).

REMARKS.—Undoubtedly, this species also occurs in South Carolina. It is not closely related to any of the other acrolophids treated here. *A. forbesi* is related to that series of species having shortened labial palpi and a type of antenna in which each segment is clothed only dorsad or dorsolaterad with scales. Specifically, *forbesi* may be distinguished from its relatives by its sparsely setose eyes, simple uncus, and fused gnathos. It may be further distinguished from its congeners by its harpe and aedeagus, the vesica of the latter structure being armed with fifteen to twenty small cornuti. The genital structure of *forbesi* is consistent throughout my series of this rather small species.

This species is named in honor of William T. M. Forbes, Professor of Entomology at Cornell University.

34. *Acrolophus panamae* Busck

FIGURES 164–167

Acrolophus panamae Busck, 1914, Proc. U.S. Nat. Mus. (Pub. no. 2043), vol. 47, p. 66, April (originally described from Panama. New to United States check lists).—Walsingham, 1915, Biol. Centr.-Amer., pt. 12, vol. 4, p. 381.

Busck's original description follows:

Acrolophus panamae—Male.—Labial palpi reaching vertex; first joint long and curved; second and third joints short, erect; first and second joints thickened with appressed scales, slightly projecting at apex, light ochreous gray on their inner side and at apex, dark brown exteriorly; terminal joint flattened, tolerably pointed, blackish brown with extreme tip light ochreous. Face and head light ochreous brown mixed with gray and white scales. Thorax ochreous brown. Forewing light ochreous brown mixed with white, dark brown, and black scales; pattern very poorly defined, but a broad, oblique, dark brown streak may be made out from the middle of the fold to costa just before apex, adjoining the base of which is a large, blackish brown spot on the lower edge of the cell; a series of well defined, blackish brown costal spots and some diffused marginal brown spots on terminal edge. Hindwings dark brownish fuscous. Abdomen dark brown with light ochreous underside and anal tuft. Uncus and lateral claspers slender, curved downward and inward at tip. Legs ochreous on their inner side, dark brown exteriorly; tarsal joints blackish brown with narrow ochreous annulation.

On the underside of the thorax just under the forewing is a large, dense tuft of ochreous gray hairs, which can be erected so as to obscure the sides of the head and the base of the forewings.

Alar expanse.—10–12 mm.

The females which were repeatedly taken in copulation with the males are considerably larger and with more pointed wings and rather lighter in general color. The labial palpi are hardly as long as in the males and more porrected. They have no thoracic tufts.

Alar expanse.—17–21mm.

Habitat.—Alhajuela, Cabima, Trinidad River, Tabernilla, Paraiso, and Corozal, Panama. April, May and June.

Type-specimen.—Cat. No. 16771, U.S.N.M.

In a series of more than sixty males, hardly two are quite alike and the different state of preservation adds much to the variation, but the general habitus, as well as the structural characters, makes it easy to place the species, which appears to be close to *A. ridicula* Meyrick, described from a unique male from Dutch Guiana.

MALE GENITALIA.—Vinculum typical, as in other species.

Tegumen with lateral arm of medium length and width, margins subparallel, sparsely and weakly punctate; dorsal area broad, glabrous, cephalic margin linear (not emarginate), cephalic portion upraised, caudal margin produced caudad to fill mesal emargination in base of uncus.

Harpe simple. Lateral aspect: broadest in area of costa and sacculus giving rise to arm of transtilla. Costa and sacculus fused, broad, narrowing gradually in basal and apical areas, comprising slightly more than basal half of harpe, glabrous except for punctate and setose ventrocaudal margin of sacculus. Cucullus indistinctly fused with costa and sacculus, directed somewhat ventrad, apical two-thirds sparsely and coarsely punctate and setose (especially entad and along margins), mesal portion constricted ventrad, ventral margin thickened and irregular; dorsal margin thin, smooth, and sublinear; apical third slightly expanded; apex broad, with irregular margin, ventral portion evenly rounded, dorsal portion subtruncate.

Transtilla with arm well sclerotized, glabrous, rather broad, less than one-fourth as long as harpe, widely separated from costal margin, terminating a little above base of harpe.

Uncus very obscurely bifid. Dorsal aspect: base separated from tegumen by narrow area of reduced sclerotization, cephalic margin broadly emarginate mesad, mesal area glabrous; lateral areas heavily sclerotized, sparsely punctate and setose, gradually converging distad and smoothly fusing into bases of furcae; angle of bifurcation extremely acute and obscure, located beyond midpoint of main uncal process; furcae short, approximate, appearing as single process (especially in untreated specimens), heavily sclerotized, directed caudad and slightly ventrad, lateral margins sparsely punctate and setose, apices acute and very slightly divergent.

Gnathos fused, rather short and broad, directed caudoventrad, dorsal portion heavily scobinate; lateral margins well sclerotized, evenly converging to broadly rounded apex.

Anellus large, membranous, unarmed, juxta absent.

Aedeagus of medium length and width, somewhat shorter than harpe, cylindrical, asymmetrical, glabrous, sublinear in dorsal and ventral aspects, slightly sinuate in lateral aspect, approximate basal third broadly expanded laterad and dorsad, approximate basal fourth opening broadly dorsad, extremity of base markedly emarginate mesoventrad, apex opening broadly; apical extremity of aedeagus consisting of very slender, weakly sclerotized extension curving gradually ventrad and terminating in rather small, acute, well sclerotized, spinelike process superficially appearing as cornutus of adjacent vesica.

Vesica rather small, membranous; unarmed, but attached to and appearing to bear spinelike process of extension of aedeagus.

TYPE.—Type ♂ (type no. 16771) in the U.S. National Museum.

TYPE LOCALITY.—Cabima, Panama, Central America.

DISTRIBUTION.—Panama northward into eastern United States. North Carolina and New Jersey.

SOURCES OF MATERIAL.—American Museum of Natural History (1 ♂); U.S. National Museum (1 ♂, 1 ♀).

SPECIMENS EXAMINED.—3 (2 ♂♂, 1 ♀), from 2 localities:

NEW JERSEY: New Lisbon, Burlington Co., ♂ (July 17, 1931, at light, E. P. Darlington), ♀ (July 14, 1932, at light, Darlington). NORTH CAROLINA: Maxton, Robeson Co., ♂ (no date, A. B. Klots).

REMARKS.—This small species is recorded here from the United States for the first time. It is not closely related to any of the other acrolophids known to occur in America north of Mexico. *A. panamae* is related to that series of species having shortened labial palpi and a type of antenna in which each segment is clothed only dorsad or dorsolaterad with scales. Aside from these general features, *panamae* may be distinguished from the other members of the genus by its naked eyes, fused gnathos, and very obscurely bifid uncus. It may be further distinguished from its congeners by its harpe and aedeagus, the vesica of the latter structure being unarmed. The genitalia of *panamae* are suggestive of those of *furcatus*, especially in regard to their respective unci and aedeagi. However, the harpes and antennae of the two species are quite distinct.

I have examined the type ♂ specimen at the U.S. National Museum. It is labeled "*Acrolophus panamae* Busck, type no. 16771, Cabima, Panama, May 1911, August Busck." My examination of a slide preparation of the ♂ genitalia of a "cotype" of *panamae* from Rio Trinidad, Panama, further confirmed the identity of this species.

It is apparently quite common in Central America, the U.S. National Museum having numerous specimens.

35. *Acrolophus juxtatus*, new species

FIGURES 168–171

Female unknown.

MALE.—Head, labial palpi, antennae, and thorax ochreous tinged with fuscous. Labial palpi shortened, partially recurved over head and extending well above and beyond antennal bases, rather densely clothed with slender scales, basal portions narrowly separated from each other but closely appressed to head, apical portions closely appressed to each other and extending above head, apical segments becoming increasingly fuscous distad. Eyes moderately large and protruding, naked, rather heavily lashed. Antennae strongly bipectinate, densely covered dorsad by scales; segmental processes slender and broadly separated from one another in lateral aspect, free of scales but finely ciliated. Forewings brown with dark brown or fuscous markings consisting of short bars along costal margin, large spot at outer end of cell, and patch bordered by two paler areas on and beneath center of fold. Color pattern of forewings somewhat variable. Hindwings and fringes brown. Abdomen covered with pale brownish scales, these in turn largely covered by elongate hairs of similar color. Wing expanse: 22 mm.

MALE GENITALIA.—Vinculum typical, as in other species.

Tegumen glabrous; lateral arm with central portion broad, evenly narrowing toward extremities; dorsal area of medium width, caudal margin indistinctly fusing mesad with base of uncus.

Harpe simple. Lateral aspect: costa and sacculus fused, comprising somewhat less than basal two-thirds of harpe, glabrous except for elongate setose area along ventrocaudal margin of sacculus, central portion broadly and evenly expanded ventrad, basal third evenly narrowing to slender basal extremity, apical third somewhat narrowed distad. Cucullus partially separated from costa and sacculus by ventral constriction and small area of reduced sclerotization, directed considerably mesad and ventrad, heavily punctate and setose ectad and entad except for small glabrous area at base, approximate basal fourth somewhat narrowed ventrad, apical three-fourths rather broad and with central portion slightly expanded dorsad and ventrad, apex broadly and evenly rounded.

Transtilla with arm glabrous, well sclerotized, slightly more than one-fifth as long as harpe, basal portion considerably expanded (especially dorsad), apical portion curving ventrad to costa, terminating subacutely at basal extremity of harpe.

Uncus single. Dorsal aspect: rather large, subtriangular; base with cephalic margin indistinctly fusing with tegumen, large mesal area rather weakly sclerotized and glabrous; lateral margins of base heavily sclerotized, set off from tegumen by areas of reduced sclerotization, sparsely punctate and setose, sublinear, gradually converging distad into uncal process; uncal process rather robust, well sclerotized, concave beneath, curving considerably ventrad, apex subacute.

Gnathos fused, large and broad, considerably flattened dorsoventrad, curving ventrocaudad, mesobasal portion rather weakly sclerotized, apical portion becoming fairly well sclerotized and scobinate distad, lateral margins well sclerotized, apex very broadly and evenly rounded.

Anellus large, membranous, armed mesocaudad with juxta. Juxta large but rather weakly sclerotized, consisting of subsymmetrical pouch opening at cephalic and caudal extremities, surrounding and serving as guide for aedeagus, approximately one-third as long as aedeagus, base truncate, lateral margins diverging distad, apical extremity almost twice as broad as basal extremity, ventral portion of apical margin broadly emarginate, ental surface striate (especially in dorsal and apical portions), ectal surface rather densely covered with extremely small seta-like processes.

Aedeagus considerably reduced, slightly more than half as long as harpe, asymmetrical, sublinear in all aspects; base somewhat expanded, emarginate ventrad, opening dorsad; approximate basal half cylindrical; central portion with dextral margin somewhat expanded and produced into one large and several minute, acute, well sclerotized, spinelike processes directed distad; approximate apical half broadly opening dorsad and consisting of broad ventral strip irregularly narrowing distad and terminating in narrowly rounded apex.

Vesica medium sized, membranous, unarmed.

TYPE.—Holotype ♂ (type no. 61445) in the U.S. National Museum.

PARATYPES (2 ♂♂).—Illinois State Natural History Survey (1 ♂); U.S. National Museum (1 ♂).

TYPE LOCALITY.—Pecos, San Miguel Co., N. Mex. (July 17, T. D. A. Cockerell).

DISTRIBUTION.—Western United States. New Mexico and Utah.

SPECIMENS EXAMINED.—3 (all ♂♂), from 2 localities:

NEW MEXICO: Pecos, San Miguel Co., 2 ♂♂ (July 17, T. D. A. Cockerell).
UTAH: Salt Lake City, Salt Lake Co., ♂ (no date, Andreas Bolter collection).

REMARKS.—This moth is quite rare in collections. It is not closely related to any of the other acrolophids known to occur in America north of Mexico. *A. juxtatus* is generally related to those species having shortened labial palpi. Specifically, it may be characterized by its

combination of rather short labial palpi, naked eyes, strongly bipectinate antennae, simple uncus, and fused gnathos. In addition, the genital characters of *juxtatus* are also quite distinct from those of all the other species treated here. Its uncal process and harpe are characteristically shaped, its aedeagus is markedly asymmetrical and distinctive, and its anellus is armed with a prominent juxta.

The name, *juxtatus*, is derived from the Latin word, *juxta*, meaning "near to, nigh," and the suffix, *-atus*, meaning "provided with." In the terminology of the Lepidoptera, the adverb, *juxta*, has been taken from the Latin and directly applied as the name of a male genital structure. It is used here in this sense, referring to the presence of a distinct and characteristic juxta in this species.

36. *Acrolophus chiricahuae*, new species

FIGURES 172-174

Female unknown.

MALE.—Somewhat resembling *dorsimaculus* in general habitus. Head, labial palpi, and thorax ochreous suffused with fuscous. Labial palpi intermediate in length, recurved back over head and extending across anterior third of thorax, closely appressed to head and to each other, strongly diverging from thorax distad, clothed with slender scales. Eyes large, protruding, naked, moderately lashed. Antennae strongly bipectinate, ochreous, covered dorsad by scales; segmental processes rather robust but well separated from one another in lateral aspect, free of scales but finely ciliated. Forewings with color pattern quite variable, ground color and markings various shades of brown; costal margin with alternate dark and light bars, apical and posterior margins with broad ochreous patches, apical third with irregular brownish marking between outer end of cell and apex, basal two thirds deep brown above fold. Hindwings and fringes pale brown. Abdomen brown, tinged with fuscous beneath. Wing expanse: 26 to 28 mm.

MALE GENITALIA.—Vinculum typical, as in other species, well sclerotized.

Tegumen glabrous; lateral arm broadest in central portion, narrowing toward extremities, margins sinuate; dorsal area narrow.

Harpe simple. Lateral aspect: rather elongate and slender, sinuate, with approximate apical quarter curving considerably ventrad; costa and sacculus fused, comprising basal half of harpe, glabrous except for punctate and setose ventrocaudal portion of sacculus, broadest in apical third, gradually narrowing basad to subacute basal extremity; cucullus indistinctly separated from costa and sacculus by ental area of reduced sclerotization, comprising approximate apical half of harpe; very heavily punctate and setose ectad and entad ex-

cept for small, glabrous, dorsobasal area; basal half slender, with margins subparallel, curving somewhat dorsad; apical half moderately expanding distad, curving considerably ventrad; apex broad, truncate, with dorsal extremity rounded, ventral extremity angulate.

Transtilla with arm very short, approximately one-seventh as long as harpe, broad, well sclerotized, glabrous, rather closely subparallel with dorsal margin of costa, terminating acutely considerably distad of basal extremity of harpe.

Uncus simple. Dorsal aspect: base small, concave beneath, set off from tegumen by areas of reduced sclerotization; glabrous except for small, finely punctate and setose, caudolateral areas; lateral margins well sclerotized, strongly converging distad into base of uncal process; uncal process elongate, rather robust, curving caudoventrad, well sclerotized, with faint trace of median longitudinal suture, major portion glabrous, apical third finely punctate and setose ventrad, narrowing only slightly to subacute apex.

Gnathos fused, large, flattened dorsoventrad, directed caudoventrad, large mesobasal portion membranous to weakly sclerotized, apical portion finely but densely scobinate entad, lateral margins heavily sclerotized and converging distad into smoothly and evenly rounded apex.

Anellus large, membranous, unarmed but with portion encircling aedeagus weakly sclerotized and suggesting trace of juxta.

Aedeagus approximately two-thirds as long as harpe, slender, cylindrical, asymmetrical, sublinear in dorsal and ventral aspects, basal extremity and approximate apical third curving considerably ventrad in lateral aspect, base weakly expanded laterad and emarginate mesad, rather small apical portion opening dorsad; apex irregularly rounded and with dextral margin produced distad into small, well sclerotized, acute, spinelike process.

Vesica small, membranous, unarmed.

TYPE.—Holotype ♂ (type no. 61446) in the U.S. National Museum.

PARATYPES (3 ♂♂).—U.S. National Museum (3 ♂♂).

TYPE LOCALITY.—Chiricahua Mountains, Cochise Co., Ariz. (Aug. 16–23, collector unknown).

DISTRIBUTION.—Southwestern United States. Southern Arizona.

SPECIMENS EXAMINED: 4 (all ♂♂), from 2 localities:

ARIZONA: Chiricahua Mountains, Cochise Co., ♂ (June 16–23, collector unknown), ♂ (Aug. 16–23, collector unknown), ♂ (date and collector unknown, labeled "*Felderia dorsimacula* Dyar" in Dyar's handwriting); locality and date unknown, ♂ ("So. Arizona," O. C. Poling).

REMARKS.—This species undoubtedly ranges southward into Mexico. It appears to be quite rare in collections. Although *A. chiricahuae* is not closely related to any of the other acrolophids known to occur in America north of Mexico, its strongly bipectinate antennae, naked

eyes, simple uncus, and fused gnathos are quite similar to those of *juxtatus*. However, the labial palpi of *chiricahuae* are intermediate in length and noticeably extend onto the anterior margin of the thorax, whereas those of *juxtatus* are rather short and barely extend onto the thorax. Further, the genital differences between these two species are quite marked. Their unci, harpes, and aedeagi are respectively distinct. Lastly, the anellus of *chiricahuae* is unarmed or bears only a faint trace of a juxta. In general, the genitalia of *chiricahuae* seem more similar to, but still distinct from, those of *minor*.

37. *Acrolophus fervidus* Busck

FIGURES 175–176

Acrolophus fervidus Busck, 1913, Proc. Ent. Soc. Washington, vol. 14, no. 4, pp. 222–223, Jan. (originally described from Mexico. New to United States check lists).—Walsingham, 1915, Biol. Centr.-Amer., pt. 12, vol. 4, p. 385.—Kaye, 1925, Trans. Ent. Soc. London, 1924–1925, p. 428, pl. 45, fig. 2.

Neolophus antonellus Barnes & McDunnough, 1913, Can. Ent., vol. 45, no. 12, p. 419, pl. 16, fig. 3, Dec. (fig. 4 is incorrectly labeled *Eulepiste antonellus*. *Neolophus antonellus* is shown only at fig. 3). (New synonymy.)

Acrolophus antonellus Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8159.—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 103, no. 9545.

Busck's original description follows:

Acrolophus fervidus—Labial palpi erect, reaching just beyond vertex, loosely haired, light ochreous with dark brown base. Antennae short, stout, light ochreous. Head and thorax reddish ochreous; patagina light ochreous with a reddish brown longitudinal stripe. Forewings whitish ochreous, heavily overlaid with bright reddish-brown scales, especially on basal two-thirds; on the middle of the wing from base to lower corner of the cell is a broad unmottled whitish streak, edged above and below with dark brown; above this is a black longitudinal line from the middle to the end of the cell terminating in a small black spot; veins 2 to 5 are indistinctly traced by dark brown lines; cilia with alternate whitish ochreous and reddish-brown tufts. Hind wings of a rich dark brown color with light ochreous cilia. Abdomen blackish brown above; dusky ochreous below; anal tuft ochreous. Legs clothed with mixed ochreous reddish and black hairs. Alar expanse, 28 to 32 mm.

Habitat: Orizaba, Mexico, R. Müller, collector. June.

Type: No. 15419, U.S. National Museum.

In the National Museum is also a large series of this species from Sixola River and Turialba, Costa Rica, William Schaus, collector.

MALE GENITALIA.—Vinculum large, heavily sclerotized, otherwise typical.

Tegumen glabrous; lateral arm elongate, slender, gradually narrowing to point of articulation with vinculum, margins moderately sinuate, dorsal margin rather weakly sclerotized, ventral margin heavily sclerotized; dorsal area rather broad, with caudal margin

evenly expanded to occupy large mesal emargination in base of uncus. Harpe simple. Lateral aspect: broad, robust; costa and sacculus fused, comprising slightly more than basal half of harpe, glabrous except for punctate and setose ventrocaudal margin of sacculus, broadest in apical third at point of attachment of arm of transtilla, approximate basal two-thirds gradually and evenly narrowing basad to narrowly rounded basal extremity, dorsal and ventral margins sublinear; cucullus partially and indistinctly separated from costa and sacculus by irregular areas of reduced sclerotization, ectal surface glabrous, ental surface sparsely and finely punctate and setose, dorsal margin heavily sclerotized and weakly sinuate, ventral margin moderately sclerotized and sublinear, moderately expanded at base, considerably narrowed dorsad and ventrad somewhat distad of base, approximate apical two-thirds expanding considerably ventrad and markedly dorsad to form unusually broad apex; apex evenly emarginate near ventral extremity, with dorsal and ventral extremities rounded.

Transtilla with arm short, approximately one-sixth as long as harpe, well sclerotized, glabrous, weakly sinuate, strongly diverging from dorsal margin of costa, terminating acutely far distad of basal extremity of harpe.

Uncus obscurely bifid, similar to that of *persimplex*. Dorsal aspect: base largely separated from tegumen by areas of reduced sclerotization, cephalic margin with broad and deep mesal emargination entirely occupied by large caudal expansion of tegumen, mesal area moderately sclerotized and glabrous; lateral margins very heavily sclerotized, sparsely punctate and setose distad, sublinear, gradually converging distad into bases of furcae; angle of bifurcation extremely small, acute, located near midpoint of main uncal process; furcae approximate, appearing almost as single process in dried specimens, of medium length and width, heavily sclerotized, directed caudad and curving slightly ventrad, lateral margins sparsely and finely punctate and setose, apices acute.

Gnathos fused, similar to that of *persimplex*, large and broad, curving ventrocaudad, large mesobasal portion membranous to weakly sclerotized, lateral margins and apical portion well sclerotized; approximate apical third considerably thickened dorsoventrad, heavily scobinate dorsad, densely clothed ventrad with minute seta-like processes; lateral margins evenly converging distad into broadly rounded apex; apex very weakly emarginate.

Anellus large, membranous, unarmed, juxta absent.

Aedeagus slender, rather elongate, slightly longer than harpe, glabrous, cylindrical, asymmetrical, sublinear in lateral aspect, basal and apical portions curving somewhat sinistrad in dorsal and ventral aspects, approximate basal fifth moderately expanded laterad and

opening broadly dorsad, basal extremity weakly and irregularly emarginate ventrad, approximate apical seventh moderately expanded dorsoventrad and irregularly opening dextrad; apex produced into prominent, heavily sclerotized, acute, sinuate, recurved, sinistral, spinelike process approximately one-fourth as long as aedeagus.

Vesica small, membranous; densely clothed with extremely small, slender, finely acute, needlelike processes or spicules.

TYPE.—Type ♂ (type no. 15419) in the U.S. National Museum.

TYPE LOCALITY.—Orizaba, Mexico.

DISTRIBUTION.—Central America and Mexico northward into southwestern United States. Texas.

SOURCE OF MATERIAL.—U.S. National Museum (2 ♂♂).

SPECIMENS EXAMINED.—2 (both ♂♂), from 2 localities:

COSTA RICA: Sixola River, ♂ (no date, William Schaus collection). This specimen is from the type series representing *fervidus*. It is labeled "*Acrolophus fervidus* Busck, cotype, U.S.N.M. type no. 15419." TEXAS: San Antonio, Bexar Co., ♂ (no date, William Barnes collection). This specimen is the holotype of *antonellus* (Barnes & McDunnough), treated below as a synonym of *fervidus*.

REMARKS.—This species is recorded here from the United States for the first time. It is closely related to *persimplex* and the complex species, *sinclairi*, forming with them a rather distinct species group. Briefly, this group may be characterized as having shortened labial palpi, antennae in which each segment is clothed only dorsad or dorsolaterad with scales, obscurely bifid uncus, fused gnathos, and a type of harpe in which the cucullus is very broadly expanded. The members of the *persimplex-fervidus-sinclairi* species group may be distinguished from one another on the basis of antennal and genital characters.

A. fervidus may be distinguished from its close relatives by its rather unusual color pattern, the shape of its cucullus, and its characteristic aedeagus. The apex of the latter organ is produced into a prominent, recurved process in this species. The antennal structure of *fervidus* represents a transition between the laminate and unipectinate types. Within the species group in question, *fervidus* is most closely related to *persimplex* on the basis of antennal and genital structure. However, the harpe and aedeagus of *fervidus* are quite distinct from those of *persimplex* as well as from those of all the other species of *Acrolophus* known to occur in America north of Mexico.

I have examined the type ♂ specimen at the U.S. National Museum. It is labeled "*Acrolophus fervidus* Busck, type no. 15419, Orizaba, Mexico, May 1908." Dr. Clarke removed the genitalia of the type for me and the identity of this species was further confirmed. It is apparently quite common in Central America.

Walsingham (1915) further reported *fervidus* from Panama and Colombia, South America. In addition, information on file at the U.S. National Museum shows that this species has been reared from the roots of orchids from Colombia, South America. Kaye (1925) published a color reproduction (half specimen) of the adult of this insect.

Barnes and McDunnough described *Neolophus antonellus* as a new species in 1913. The description was based on a single ♂ specimen collected at San Antonio, Tex. The type, then deposited in the Barnes collection, was listed as having a wing expanse of 33 mm. The figure cited is a photograph showing the pinned and spread moth in dorsal aspect. The species name was apparently taken from the type locality, San Antonio. Since 1913, *antonellus* has appeared in the literature as a distinct species.

The type ♂, in the U.S. National Museum and labeled "*Neolophus antonellus* B. & McD., type no. 61453, San Antonio, Texas," appears similar to the type ♂ of *A. fervidus*. Dr. Clarke removed the genitalia of both types and they were identical. The moths themselves also proved to be the same in all respects.

Thus, *antonellus* (Barnes & McDunnough) should be considered a new synonym of the slightly older Mexican species, *fervidus* Busck. The type of *antonellus* is the only specimen of *fervidus* that has been recorded from the United States, so far as I know.

38. *Acrolophus persimplex* (Dyar)

FIGURES 177-180

Neolophus persimplex Dyar, 1900, Can. Ent., vol. 32, no. 11, p. 327, Nov.; 1903, List North Amer. Lep., p. 577, no. 6578.

Acrolophus (*Neolophus*) *persimplex* Busck, 1912, Proc. Ent. Soc. Washington, vol. 14, no. 3, p. 184.

Acrolophus persimplex Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8155.—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 103, no. 9541.

Dyar's original description follows:

Neolophus persimplex—Palpi short, erect, reaching to vertex of head, and closely appressed, densely hairy, slightly tufted on the joints, the third joint smoother. Body robust, in size and appearance resembling *Pseudanaphora davisellus*, Beut., but veins 8 and 9 of fore wings stalked. Antennae subserrate, especially towards tips. Head and thorax dark gray. Fore wing pale cinerous gray, mottled with black, heaviest in the centre of the wing, the dark area forming a quadrate or pointed patch on the centre of the inner margin, and a diffuse discal patch, becoming merged in the mottlings along costal edge of wing; area along inner margin lighter gray. Hind wings dark gray. Expanse 22 to 24 mm. Male genitalia with the uncus a single long spine tapering from a broad base, obliquely bent downward; harpes broad, concave, strongly widened at tips, rounded with a slight projection on the terminal margin.

Nine examples; Huachuca Mts., Arizona; July 16 to Aug. 23 (Dr. W. Barnes); U.S. Nat. Mus., type No. 5343.

MALE GENITALIA.—Vinculum typical, as in other species.

Tegumen glabrous, width medium; lateral arm narrowing gradually to point of articulation with vinculum, cephalic margin weakly sinuate, caudal margin sublinear and well sclerotized; dorsal area with cephalic margin sinuate and broadly emarginate mesad, caudal margin irregular and partially fusing with base of uncus.

Harpe simple but with distinct clasper arising from inner surface of cucullus, very broad and robust. Lateral aspect: costa and sacculus fused, comprising approximate basal four-sevenths of harpe, glabrous except for rather large ventrocaudal area of sacculus clothed with elongate setae, broadest at point of attachment of arm of transtilla, approximate basal three-fourths narrowing to very narrow basal extremity, apical portion abruptly narrowed dorsad at point of fusion with base of cucullus. Cucullus indistinctly fused with costa and sacculus, very sparsely punctate and setose, base broad, dorsal and ventral margins heavily sclerotized, dorsal margin markedly sinuate, ventral margin evenly expanding ventrad toward apex; apex very broad, irregularly and bluntly rounded; well sclerotized ental area arising from ventral margin of central third of cucullus curving dorsocephalad and terminating near dorsobasal extremity of cucullus in heavily sclerotized, acute clasper curving toward meson of genital capsule.

Transtilla with arm glabrous, well sclerotized, considerably reduced, only one-sixth to one-seventh as long as harpe, broadly separated from margin of costa, terminating acutely far caudad of basal extremity of harpe.

Uncus obscurely bifid. Dorsal aspect: base largely separated from tegumen by areas of reduced sclerotization, cephalic margin with broad and deep mesal emargination mostly occupied by large caudal expansion of tegumen, mesal area rather weakly sclerotized and glabrous; lateral margins of base heavily sclerotized, sparsely punctate and setose, weakly sinuate, converging caudad into bases of furcae; angle of bifurcation extremely small, acute, located near midpoint of main uncal process; furcae approximate, appearing almost as single process in dried specimens, length medium, rather narrow, heavily sclerotized, directed caudad and slightly ventrad, lateral margins sparsely punctate, apices acute and slightly divergent.

Gnathos fused, large and broad, curving ventrocaudad, mesal portion of basal half weakly sclerotized; approximate apical half fairly well sclerotized, considerably thickened dorsoventrad, heavily scobinate dorsad, densely clothed ventrad with minute seta-like

processes; lateral margins heavily sclerotized, sublinear, converging distad to broadly and evenly rounded apex.

Anellus large, membranous, unarmed, juxta absent.

Aedeagus rather slender, length medium, approximately five-sixths as long as harpe, glabrous, cylindrical, asymmetrical, linear in dorsal and ventral aspects, sinuate in lateral aspect with basal portion curving somewhat dorsad and apical portion curving somewhat ventrad; approximate basal fourth slightly expanded, opening broadly dorsad, very weakly emarginate ventrad; remainder of aedeagus gradually and evenly narrowing distad; approximate apical three-tenths opening broadly sinistrad and consisting simply of well sclerotized dextral strip produced near apex into small, heavily sclerotized, acute, spinelike process directed dextrad.

Vesica medium sized, membranous, unarmed.

TYPE.—Type ♂ (type no. 5343) in the U.S. National Museum.

TYPE LOCALITY.—Huachuca Mountains, Ariz.

DISTRIBUTION.—Southwestern United States. Arizona.

SOURCES OF MATERIAL.—California Academy of Sciences (7 ♂♂); Carnegie Museum (2 ♂♂).

SPECIMENS EXAMINED.—9 (all ♂♂), from 2 localities:

ARIZONA: Huachuca Mountains, 2 ♂♂ (Carr Canyon, Aug. 5, 1924, J. O. Martin), 5 ♂♂ (Carr Canyon, Aug. 7, 1924, E. P. Van Duzee); Palmerlee, Cochise Co., ♂ (date and collector unknown); locality and date unknown, ♂ ("Arizona," Engel collection).

REMARKS.—This species undoubtedly ranges southward into Mexico. It is closely related to *fervidus* and the complex species, *sinclairi*, forming with them a rather distinct species group. This group, consisting of fairly large and robust moths, has been characterized in the foregoing remarks on *fervidus*. *A. persimplex* may be distinguished from its close relatives, as well as from the other members of the genus, by its color pattern, the shape of its aedeagus, and by the presence of a distinct clasper on the inner surface of the cucullus of its harpe. The antennae of *persimplex* are quite similar to the peculiar type exhibited by *fervidus*, and they are perhaps best described as representing a transitional form between reduced lamination and reduced unipectination. The genital structure of *persimplex* is consistent throughout my specimens representing this species.

I have examined the type ♂ specimen at the U.S. National Museum. It is labeled "*Neolophus persimplex* Dyar, type no. 5343, Huachuca Mts., Ariz., Aug. 8–15." Dr. Clarke removed the genitalia of the type for me and the identity of this species was further confirmed. In the antennae of the type specimen, each segmental process exhibits the characteristic, minute, spinelike structure at its apex. My examination of a slide preparation of ♂ genitalia labeled "*Acrolophus*

persimplex Dyar, Cotype, Huachuca Mts., Ariz., Aug. 8–15" gave additional confirmation to the identity of this species.

39. *Acrolophus sinclairi*, new species

This complex species is composed of the two new subspecies described below.

39a. *Acrolophus sinclairi sinclairi*, new subspecies

FIGURES 181–183

MALE.—Head, labial palpi, and thorax ochreous tinged with white and fuscous. Labial palpi short, partially recurved but not extending to antennal bases, rather narrowly separated from each other, closely appressed to head except at apices, densely clothed with slender scales. Eyes large, protruding, naked, weakly lashed. Antennae unipectinate, ochreous, covered dorsolaterad with scales; segmental processes (fig. 181) subcircular in transverse section, developed ventrad rather than laterad, somewhat thickened but well separated from one another in lateral aspect, free of scales but covered with elongate setae. Forewings with variable color pattern, ground color pale brown, finely sprinkled with fuscous, marked with dark brown; markings consisting of faint spots along costa, narrow bar at outer end of cell, and irregular patch extending from fold to center of posterior margin. Hindwings pale brown, fringes brownish-white. Abdomen pale brown, covered with broad scales rather densely overlaid with very slender scales or hair. Wing expanse: 24 to 30 mm.

FEMALE.—Coloration similar to that of ♂, pattern variable as in ♂. Labial palpi slightly shorter than those of ♂, directed upward and forward, narrowly separated from each other, basal halves closely appressed to head, densely clothed with both broad and slender scales. Eyes essentially same as those of ♂. Antennae similar to those of ♂ but with segmental processes considerably smaller. Forewings brown, heavily sprinkled with fuscous. Hindwings, fringes, and abdomen colored as in ♂. Wing expanse: 26 to 29 mm.

MALE GENITALIA.—Vinculum in form of rather narrow, heavily sclerotized, lateroventral band.

Tegumen glabrous; lateral arm rather broad but gradually narrowing to point of articulation with vinculum, cephalic margin sinuate, caudal margin sublinear and well sclerotized; dorsal area very broad, cephalic margin sinuate and with broad but shallow mesal emargination, caudal margin fusing mesad with base of uncus.

Harpe simple, broad. Lateral aspect: costa and sacculus fused, comprising somewhat more than basal half of harpe, glabrous except for large punctate and setose ventrocaudal area of sacculus, broadest at point of attachment of arm of transtilla, approximate basal half

irregularly narrowing to narrow basal extremity, apical portion abruptly narrowed dorsad at point of fusion with base of cucullus. Cucullus only partially set off from costa and sacculus by areas of reduced sclerotization, sparsely punctate and setose about margins (especially entad), base broad, dorsal margin sublinear, approximate apical half slightly to markedly expanded ventrad; apex very broad, broadly and evenly rounded dorsad, bluntly to narrowly rounded ventrad.

Transtilla with arm glabrous, well sclerotized, short, approximately one-fifth as long as harpe, basal two-thirds diverging from and apical third converging toward margin of costa, terminating subacutely considerably caudad of basal extremity of harpe.

Uncus obscurely bifid, subtriangular, similar to that of *griseus*. Dorsal aspect: base large, glabrous, mesal portion of cephalic margin fusing with tegumen; lateral margins of base set off from tegumen by irregular areas of reduced sclerotization, heavily sclerotized, sparsely punctate and setose, converging caudad into furcae; angle of bifurcation entirely obscured; furcae approximate, appearing as single process with median longitudinal suture (especially in dried or untreated specimens), elongate, narrow, heavily sclerotized, directed caudad and slightly ventrad, lateral margins sparsely punctate and setose, apices acute.

Gnathos fused, large and broad, curving ventrocaudad, mesal portion of basal half very weakly sclerotized; approximate apical half fairly well sclerotized, considerably thickened dorsoventrad, heavily scobinate dorsad, densely clothed ventrad with minute seta-like processes; lateral margins heavily sclerotized, converging distad to very broadly and evenly rounded apex.

Anellus large, membranous, unarmed, juxta absent.

Aedeagus rather slender, length medium, approximately six-sevenths as long as harpe, cylindrical, asymmetrical, glabrous, sinuate in dorsal and ventral aspects, approximate apical fourth curving somewhat ventrad in lateral aspect; base slightly expanded laterad, emarginate ventrad, opening dorsad; central portion somewhat narrowed, gradually expanding again toward apex; approximate apical third opening broadly and irregularly and consisting simply of sclerotized, dextral strip terminating distad in small, well sclerotized, acute, spinelike process directed sinistrad.

Vesica fairly large, membranous, unarmed.

TYPE.—Holotype ♂ and allotype ♀ (type no. 61447) in the U.S. National Museum.

PARATYPES (13 ♂♂, 2 ♀♀).—California Academy of Sciences (5 ♂♂, 1 ♀); Denison University (1 ♂); U.S. National Museum (7 ♂♂, 1 ♀).

TYPE LOCALITY.—Mohave Co., Ariz. (June, collector unknown).

DISTRIBUTION.—Southwestern United States. Arizona, New Mexico, and Texas.

SPECIMENS EXAMINED.—17 (14 ♂♂, 3 ♀♀), from 4 localities:

ARIZONA: Boulder Springs, Mohave Co., ♂ (July 1–15, 1921, O. C. Duffner); Mohave Co., 7 ♂♂, ♀ (June 8–15, one ♂ with mites, collector unknown), ♀ (June 16–23, collector unknown), ♂ (July 8–14, collector unknown). NEW MEXICO: Carlsbad Cavern, Eddy Co., 4 ♂♂ (May 16, 1927, J. O. Martin), ♀ (May 17, 1927, Martin). TEXAS: Alpine, Brewster Co., ♂ (May 5, 1927, J. O. Martin).

REMARKS.—This subspecies should also be found in the southern portions of Utah, Nevada, and California. In addition, it undoubtedly ranges southward into Mexico.

The complex species, *sinclairi*, is closely related to *persimplex* and *fervidus*, forming with them a rather distinct species group. This group has already been characterized in the foregoing remarks on *fervidus*. *A. sinclairi* may be distinguished from its close relatives, as well as from the other members of the genus, on the basis of its antennal and genital structure. The antennae may be either unipectinate or reduced bipectinate.

The subspecies, *sinclairi sinclairi*, may be separated from its companion subspecies, *sinclairi nelsoni*, on the basis of antennal structure. The former exhibits unipectinate antennae and the latter has antennae of a reduced bipectinate type, both conditions being described in detail in couplet 48 of the key (p. 519). The two subspecies have different geographical distributions. They can not be satisfactorily distinguished from each other by genital differences. The genitalia of *sinclairi sinclairi* exhibit affinities with those of the complex species, *griseus*, although their respective aedeagi are quite distinct and the two are generally dissimilar in regard to other structures. The cucullus of the harpe in *sinclairi sinclairi* is somewhat variable. In the specimens from Arizona, the ventral portion of the apex of this structure is quite markedly expanded ventrad, whereas the specimens from New Mexico and Texas exhibit a correspondingly less pronounced expansion. This subspecies is named for the George M. Sinclair family of Urbana, Ill.

39b. *Acrolophus sinclairi nelsoni*, new subspecies

FIGURES 184–185

MALE.—Coloration and structure, except for antennae, essentially same as in *sinclairi sinclairi*. Head, labial palpi, and thorax ochreous tinged with white. Labial palpi short, partially recurved but not extending to antennal bases, narrowly separated from each other, closely appressed to head except at apices, densely clothed with slender scales. Eyes rather small, weakly protruding, naked, moderately lashed. An-

tennae reduced bipectinate, ochreous, covered dorsad with scales; each segmental process (fig. 185) somewhat emarginate mesad in transverse section, developed strongly laterad into pair of secondary processes narrowly rounded at apices, quite slender in lateral aspect, free of scales but covered with elongate setae. Forewings with color pattern somewhat variable, ground color pale brown, marked with dark brown or fuscous; markings consisting of short bars along costa, distinct spot at outer end of cell, and suffused patch extending from fold to center of posterior margin. Hindwings brown, fringes brownish white. Abdomen pale brown, covered with broad scales very densely overlaid with elongate hairs. Wing expanse: 25 to 26 mm.

MALE GENITALIA.—The foregoing description of the genitalia of *sinclairi sinclairi* will largely suffice for those of *sinclairi nelsoni*. In the latter subspecies, the vinculum is broader and more like the typical form exhibited by the majority of acrolophids, the harpe and the arm of the transtilla (fig. 184) present a somewhat different shape in lateral aspect, and a minute angle of bifurcation may be observed in the apical fourth or fifth of the main uncal process. The other genital structures of *sinclairi sinclairi* and *sinclairi nelsoni* exhibit only minor differences between these two subspecies.

FEMALE.—Coloration similar to that of ♂. Labial palpi as in ♂ except somewhat shorter. Eyes essentially same as those of ♂, rather weakly lashed. Antennae missing (broken off just above bases). Wing expanse: 28 mm.

TYPE.—Holotype ♂ and allotype ♀ in the Illinois State Natural History Survey.

PARATYPES (3 ♂♂).—Illinois State Natural History Survey (2 ♂♂); United States National Museum (1 ♂).

TYPE LOCALITY.—Las Vegas, San Miguel Co., N. Mex. (no date, Andreas Bolter collection).

DISTRIBUTION.—Southwestern United States. New Mexico.

SPECIMENS EXAMINED.—5 (4 ♂♂, 1 ♀), from one locality:

NEW MEXICO: Las Vegas, San Miguel Co., 4 ♂♂, ♀ (no date, two ♂♂ without abdomens, Andreas Bolter collection).

REMARKS.—This subspecies is quite rare in collections. With its companion subspecies, *sinclairi sinclairi*, it forms the complex species, *sinclairi*. The latter is closely related to *persimplex* and *fervidus*, forming with them a species group. This group has been characterized in the foregoing remarks on *fervidus*.

A. sinclairi nelsoni may be separated from *sinclairi sinclairi*, as has been described in the foregoing remarks on the latter subspecies, chiefly on the basis of differences in antennal structure. In each of these two subspecies, the characteristic type of antenna is consistently exhibited by my series of specimens. Both subspecies present about

the same appearance in size and general habitus, with both exhibiting short labial palpi and naked eyes. In addition, their great similarity in regard to genital structure indicates that they are very closely related.

On the basis of the material at hand, *sinclairi sinclairi* and *sinclairi nelsoni* should be considered distinct. However, in the event that transitional forms are found to occur between the two, and this is not entirely unlikely, the resulting single species would certainly exhibit an unusual amount of variation or instability in regard to antennal structure. This subspecies is named for the Ralph W. Nelson family of Chicago.

40. *Acrolophus quadrellus* (Barnes & McDunnough)

FIGURES 186–189

Pseudanaphora quadrellus Barnes & McDunnough, 1913, Can. Ent., vol. 45, no. 12, pp. 420–421, pl. 16, figs. 1, 2, Dec. (fig.1, type ♂; fig. 2, type ♀). *Acrolophus quadrellus* Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8194.—Barnes & Lindsey, 1921, Contrib. Nat. Hist. Lep. North Amer., vol. 4, no. 4, pl. 40, fig. 7.—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 104, no. 9584.

Barnes and McDunnough's original description follows:

Pseudanaphora quadrellus—♂.—Antennae very slightly serrate below, palpi upturned, roughly haired, brown; thorax chocolate-brown; primaries chocolate brown shaded with pale ochreous especially along inner margin and termen; costa with alternate striae of chocolate-brown and ochreous; slight ochreous tinge in cell; dark discocellular dash; inner margin broadly ochreous, more or less striate with brown, upper edge of this ochreous stripe irregular with prominent blunt tooth of ground-colour projecting downward towards middle of inner margin; before and after this tooth the margin is rounded, bent sharply upwards beyond origin of vein 3 as far as vein 7, bending again at right angles and attaining termen below apex, forming a large subquadrate terminal ochreous patch; faint terminal row of dark dots; fringes checkered brown and ochreous with pale basal line. Secondaries pale smoky brown with ochreous terminal line and checkered fringes. Beneath smoky brown, costa of primaries apically ochreous with 3 or 4 brown striae, narrow terminal ochreous line, secondaries and fringes as above.

♀.—Palpi short, hairy, porrect; primaries more uniform chocolate brown with only faint traces of ochreous along inner margin; a paling of the ground colour represents the quadrate terminal patch so prominent in the ♂. Expanse ♂ 25 mm. ♀ 28 mm.

Habitat: Palmerlee, Ariz. 7 ♂, 3 ♀. Types, Coll. Barnes.

The species is allied to *davisellus* Beut., but should be readily distinguished by the dark apex and subquadrate ochreous terminal patch with sharply defined inner edge. The males vary in the amount of brown striations on the ochreous area; in some there are scarcely any, in others they show a tendency to obscure this area more or less completely.

MALE GENITALIA.—Vinculum typical, as in other species, well sclerotized.

Tegumen glabrous; lateral arm somewhat expanded below midpoint, narrowing toward basal and apical extremities; dorsal area rather narrow, undivided, with caudolateral extremities produced into pair of rounded projections at points of fusion with base of gnathos.

Harpe simple, linear. Lateral aspect: costa and sacculus typical, fused, broadest in apical portion, narrowing toward rounded base, glabrous except for sparsely setose ventral margin of sacculus. Cucullus well set off from costa and sacculus by ventral emargination, small dorsal expansion, and area of reduced sclerotization; comprising slightly more than apical half of harpe, rather elongate and slender, heavily sclerotized, heavily punctate and setose ectad and entad, dorsal margin smooth and sublinear, ventral margin markedly and irregularly dentate, apex narrowly rounded.

Transtilla with arm of medium length, rather broad, glabrous, weakly sinuate, extending to or slightly beyond basal extremity of harpe, apex weakly and irregularly expanded.

Uncus simple, except at extreme apex. Dorsal aspect: base rather weakly sclerotized, sparsely punctate and setose, cephalic margin emarginate mesad, lateral margins linear and converging distad into uncal process; uncal process indistinctly fused with base, heavily sclerotized, concave beneath, gradually narrowing distad, apical two-thirds curving considerably ventrad, apex minutely and acutely bifid.

Gnathos paired, very distinctive, glabrous; lateral margins heavily sclerotized, angle of bifurcation broadly and evenly rounded; arms elongate, broad, with apical halves narrowing distad, very heavily sclerotized and darkened, gradually diverging distad, directed ventrocaudad, apices acute.

Anellus membranous, unarmed, juxta absent.

Aedeagus rather short, slender, asymmetrical, glabrous. Lateral aspect: portion somewhat basad of center curving through angle of approximately 90° resulting in apical three-fifths of aedeagus extending almost directly ventrad, base broadly and irregularly expanded laterad and ventrad, basal half cylindrical and narrowing ventrad toward apex; major portion of apical half opening dorsad and consisting of rather narrow, well sclerotized, ventral strip with subacute apex.

Vesica elongate, slender, membranous, unarmed.

TYPE.—Holotype ♀ and ♂ and ♀ "cotypes" (type no. 61454) in the U.S. National Museum.

TYPE LOCALITY.—Palmerlee, Cochise Co., Ariz.

DISTRIBUTION.—Southwestern United States. Arizona.

SOURCES OF MATERIAL.—American Museum of Natural History

(12 ♂♂); Carnegie Museum (2 ♂♂); Ohio State University (1 ♂); University of Kansas (1 ♂).

SPECIMENS EXAMINED.—16 (all ♂♂), from 3 localities:

ARIZONA: Huachuca Mountains, ♂ (Aug. 1, 1927, mite on forewing, P. A. Readio), ♂ (July 20, 1937, with 5 mites, D. J. and J. N. Knull); Huachuca Mountains, Cochise Co., 5 ♂♂ (Ramsay Canyon, July 10–15, 1941, A. B. Klots), 7 ♂♂ (Ramsay Canyon, July 16, 1948, C. and P. Vaurie); Palmerlee, Cochise Co., ♂ (date and collector unknown); locality and date unknown, ♂ ("Arizona," Engel collection).

REMARKS.—This species undoubtedly ranges southward into Mexico. It is not closely related to any of the acrolophids known to occur in America north of Mexico. *Acrolophus quadrellus* is generally related to those species having shortened labial palpi and antennae in which each segment is clothed only dorsad or dorsolaterad with scales. Specifically, it may be easily distinguished from all other species treated here by three of its genital structures. These structures are not only distinctive but also clearly observable in undissected specimens. The apex of its uncal process is acutely bifid; the cucullus of its harpe is densely setose and prominently dentate along the ventral margin; and, its gnathos is characteristically paired by a very broadly and evenly rounded angle of bifurcation. The arms of the gnathos are divergent and elongate, with their apical halves narrowing and becoming very heavily sclerotized distad. This type of gnathos is both atypical and unique among the species under consideration. The genital structure of this fairly large acrolophid is quite consistent throughout my series of specimens.

I have examined the type ♀ specimen at the U.S. National Museum. It is labeled "*Pseudanaphora quadrellus* B. & McD., Palmerlee, Arizona." This type, along with a series of "cotypes" representing *quadrellus*, has recently been assigned a type number during the course of this revision. Since the taxonomy of this group is at present based almost entirely upon the ♂♂ of the various species, it is best to select ♂♂ for holotypes. However, the ♀ representing *quadrellus* may be correlated with the ♂♂ with reasonable certainty by reference to the Museum's determined series from which it was originally selected. This series contains a number of both sexes, all from the same locality and all labeled as "cotypes." My examination of a slide preparation of ♂ genitalia labeled "*Acrolophus quadrellus* B. & McD., Cotype, Palmerlee, Ariz." confirmed the identity of this species. Carl Heinrich loaned me two slide preparations of genitalia representing both the ♂ and ♀ paratypes of *quadrellus*. These mounts furnished further confirmation of the identity of this moth.

Contrary to the comments accompanying the original description of *quadrellus*, the latter is not at all closely related to *davisellus*.

Barnes and Lindsey (1921) have published an excellent photograph of a preparation of the entire ♂ genitalia of *quadrellus* in ventral aspect.

41. *Acrolophus minor* (Dyar)

FIGURES 190–195

Pseudanaphora davisellus subsp. *minor* Dyar, 1903, List North Amer. Lep., p. 571, no. 6601a, Jan. (only briefly mentioned in Dyar's list and rather questionable as a formal description).

Homonymus coloradellus Walsingham, 1907, Proc. U.S. Nat. Mus., vol. 33, no. 1567, p. 228, Oct. (New synonymy.)

Acrolophus coloradellus Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8177.—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 103, no. 9563.

Acrolophus davisellus minor Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8193a.—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 104, no. 9583a.

Apparently, Dyar's only published "description" of his "subspecies" consists of these words appearing in his check list of 1903:

Pseudanaphora davisellus Beut. subsp. *minor* Dyar—Smaller (than *davisellus*), the pale marks grayer and more contrasted. Ar[illegible], Tex.

Actually, *minor* is a distinct species. Although it may superficially resemble *davisellus*, the two species are not at all closely related. Thus, the combination, *Acrolophus minor* (Dyar), may be considered a new combination since *minor* is here elevated from subspecific to specific rank. This species has a single synonym, *coloradellus*, thoroughly described externally by Walsingham in 1907. To augment Dyar's extremely brief, inadequate, and unillustrated description of *minor*, Lord Walsingham's description of *coloradellus* follows:

Homonymus coloradellus

Antennae cinereous.

Palpi erect, reaching scarcely above the base of the antennae, thickly clothed throughout; mixed brownish ochreous and brownish fuscous, appearing slightly paler than the head and thorax above and below them.

Head and thorax are brownish fuscous, the scales tipped with hoary gray.

Forewings rather narrow, of about equal width throughout, except at the extreme base, the width equal about one-third the length, termen slightly convex, oblique, apex rounded.

Neuration 12 veins, all separate; dull cinereous, with some paler hoary patches running along the fold to the end of the cell, thickly sprinkled throughout with brownish ochreous and dark fuscous scales which are concentrated in some small patches, one at the end of the cell, one on, and one immediately above the fold beyond it, with a series of very obscure costal spots; cilia brownish fuscous, slightly paler along their base and mixed with brownish ocherous about the tornus; underside uniformly brownish fuscous, with narrowly pale margins.

Alar expanse.—24 mm.

Hindwings, 8 veins, all separate; slightly wider than the forewings; brownish fuscous; cilia with some paler markings.

Abdomen (missing).

Legs brownish fuscous.

Type.—Male (Walsingham determined, No. 4749, 1906), Cat. No. 10360, U.S.N.M.

Habitat.—Custer County, Westcliff, Colorado. (Collection Beutenmüller). Unique.

This agrees with the genus *Homonymus*, described from South America, but differs from the only species at present known in its shorter palpi and by the absence of deep purple coloring in the hindwings, as well as by the somewhat different pattern of the obscure markings on the forewings.

MALE GENITALIA.—Vinculum typical, as in other species.

Tegumen glabrous; lateral arm broadest in central portion, extremities narrowing, cephalic margin sublinear, caudal margin irregularly rounded; dorsal area narrow, margins sublinear; weakly sclerotized, finely pitted, transverse area lying between and fusing with caudal margin of tegumen and cephalic margin of base of uncus.

Harpe simple, rather elongate and slender (especially in apical portion). Lateral aspect: costa and sacculus fused, comprising approximate basal half of harpe, glabrous except for punctate and setose ventrocaudal area of sacculus, broadest just basad of this area, central portion somewhat expanded dorsad and ventrad, basal portion evenly narrowing to narrow basal extremity, approximate apical fourth somewhat narrowed ventrad. Cucullus somewhat variable, considerably more robust in some specimens than in others, indistinctly fused with costa and sacculus, basal half sparsely and apical half heavily punctate and setose ectad and entad, approximate basal third directed slightly dorsad and narrowing distad, approximate apical two-thirds directed somewhat ventrad and gradually expanding toward apex; apex approximately as broad as base, somewhat reduced ventrad, broadly but unevenly rounded.

Transtilla with arm glabrous, well sclerotized, somewhat sinuate, approximately one-fourth as long as harpe, subparallel with margin of costa, apical fifth converging to costa, terminating subacutely near basal extremity of harpe.

Uncus single. Dorsal aspect: base set off from tegumen by areas of reduced sclerotization, rather broad, cephalic margin with broad and shallow mesal emargination occupied by finely pitted transverse area, laterobasal extremities irregularly rounded, lateral margins converging distad quite sharply into uncal process; uncal process of medium width and length, curving caudoventrad, well sclerotized, with median longitudinal suture becoming obsolete toward apex, base sparsely punctate and setose, narrowing only slightly toward subacute apex.

Gnathos fused, large and broad, considerably flattened dorsoventrad, curving ventrocaudad, large mesal portion rather weakly sclerotized

(especially toward base), lateral margins well sclerotized and scobinate, apex broadly and evenly rounded or weakly emarginate.

Anellus large, membranous, armed ventrad with juxta. Juxta fused with basal portions of harpes and may represent developments of latter, located slightly ventrad of and articulated to dorsal margins of approximate basal three-eighths of harpes, lying just ventrad of and serving as fulcrum for aedeagus, consisting of two heavily sclerotized processes connected by membranous mesal area; processes subparallel throughout most of their length, basal portions converging and fusing with bases of harpes, apical portions somewhat expanded and divergent, basal and apical portions curving somewhat ventrad in lateral aspect.

Aedeagus rather short and slender, approximately five-eighths as long as harpe, cylindrical, asymmetrical, approximately linear in dorsal and ventral aspects, in lateral aspect apical three-fifths considerably narrowed and directed ventrad at angle of 45° and basal two-fifths irregularly expanding toward basal extremity, in dorsal aspect approximate basal fifth very broadly expanded laterad and emarginate dorsad, apical two-fifths to one-half opening broadly and irregularly dorsad and consisting of rather broad ventral strip produced ventrad near apex into prominent nodelike swelling; apex irregularly rounded and armed with approximately 10–12 small, unequally sized, well sclerotized, finely acute, spinelike processes directed distad.

Vesica medium sized, membranous, unarmed.

TYPE.—Type ♂ (type no. 1843) in the U.S. National Museum.

TYPE LOCALITY.—Kerrville, Kerr Co., Tex.

DISTRIBUTION.—Texas westward to Arizona and northward to Kansas and Colorado.

SOURCES OF MATERIAL.—American Museum of Natural History (1 ♂); Denison University (3 ♂♂); Illinois State Natural History Survey (1 ♂); University of Kansas (1 ♂).

SPECIMENS EXAMINED.—6 (all ♂♂), from 5 localities:

ARIZONA: Boulder Springs, Mohave Co., 2 ♂♂ (July 1–15, 1921, one specimen with mite on base of forewing, other with mite on abdomen, O. C. Duffner); Hualapai Mountains, ♂ (July 15–30, 1921, O. C. Duffner); McNary, Apache Co., ♂ (June 19, 1940, G. E. Pollard). KANSAS: Clark Co., ♂ (June, elevation 1962 feet, F. H. Snow). TEXAS: Locality and date unknown, ♂ ("Tex.," Andreas Bolter collection).

REMARKS.—This species probably ranges southward into Mexico. It is here recorded from Colorado on the basis of its synonym, *coloradellus* (Walsingham), the holotype ♂ of which was collected in Custer County, Colorado.

A. minor is not closely related to any of the other acrolophids known to occur in America north of Mexico. It is related to those species having shortened labial palpi, naked eyes, and complex an-

tennae in which each segment is clothed only dorsad or dorsolaterad with scales. Its antennae are of a reduced bipectinate type similar to, but still distinct from, that exhibited by *sinclairi nelsoni*. In addition, *minor* resembles that subspecies in regard to size, general habitus, labial palpi, and eyes. However, the characteristic antennae, aedeagus, and juxta of *minor* can not be confused with those of the other acrolophids treated in this work.

Dr. Clarke and I have examined the type ♂ specimen at the U.S. National Museum. It is labeled "*Pseudanaphora minor* Dyar, type no. 1843, Kerrville, Texas, April." No attempt was made to remove the genitalia of the type since its abdomen had apparently been glued on following extensive damage by dermestids. However, Dr. Clarke removed the genitalia of a ♂ "cotype" for me. This preparation, along with my examination of the type, definitely confirmed the identity of *minor*.

Walsingham described *Homonymus coloradellus* as a new species in 1907. His description and comments have already been quoted in full to augment Dyar's very brief "description" of *minor* treated above. Since 1907, *coloradellus*, based on a unique ♂ without an abdomen, has appeared in the literature as a distinct species.

The type ♂ is at the U.S. National Museum. It is labeled "*Homonymus coloradellus* Wlsm., type no. 10360, West Cliff, Custer Co., Colorado, Beutenmueller Collection." Other data with the type are "4749 Wlsm. 1906" and "821 Wlsm. MS." Although the abdomen of *coloradellus* was missing, the color pattern of its wings and its distinctive antennal structure clearly showed it to be equivalent to *minor*, the type ♂ of which I was also able to study at the National Museum. Thus, *coloradellus* (Walsingham) should be considered a new synonym of *Acrolophus minor* (Dyar).

42. *Acrolophus parvipalpus*, new species

FIGURES 196–198

MALE.—Head, labial palpi, and thorax ochreous tinged with white and fuscous. Labial palpi short, heavily clothed with scales, porrect, basal portions closely appressed to head and narrowly separated from each other, apical portions strongly diverging from head and rather broadly separated from each other, apical segments conical and becoming acute at apices. Eyes large, protruding, naked, without lashes. Antennae simple, laminate, ochreous tinged with fuscous, covered dorsolaterad by scales, segmental processes set closely together throughout antennae. Forewings with color pattern somewhat variable, ground color brown, marked with dark brown; markings consisting of small spots along costa, short bar at outer end of cell,

and diffused patch beneath center of fold. Hindwings dark brown, fringes somewhat lighter. Abdomen brown. Wing expanse: 22 to 26 mm.

FEMALE.—Coloration similar to that of ♂, pattern variable as in ♂. Labial palpi and eyes similar to those of ♂. Antennae slender, almost entirely covered by scales, segments globose rather than laminate. Wing expanse: 27 to 29 mm.

MALE GENITALIA.—Vinculum rather large and well sclerotized, but otherwise typical.

Tegumen fairly broad, glabrous; lateral arm somewhat shortened, evenly narrowing to point of articulation with vinculum, margins linear; dorsal area with cephalic margin minutely emarginate mesad, caudal margin with deep and irregular mesal emargination filled by area of weak sclerotization.

Harpe divided, with reduced costal process. Lateral aspect: costa and sacculus fused, large, considerably expanded in all aspects, comprising approximate basal half of harpe, glabrous except for punctate area along ventrocaudal margin of sacculus bearing elongate setae, broadest in apical portion caudad of point of attachment of arm of transtilla, approximate basal five-sevenths evenly narrowing dorsad and ventrad toward narrowly rounded basal extremity; costal process not greatly developed but very distinct, slightly shorter than arm of transtilla, originating at dorsocaudal extremity of costa, base broad, margins converging caudad to rather narrowly rounded apex, directed caudad and curving somewhat mesad, dorsal margin evenly continuous with that of arm of transtilla. Cucullus separated dorsad from costa and ventrad from sacculus by areas of reduced sclerotization, directed somewhat ventrad, approximate central half considerably flattened dorsoventrad and appearing quite slender in lateral aspect, approximate apical half of ventral margin heavily punctate and setose entad, remainder of cucullus very sparsely punctate and setose, approximate basal half with dorsal and ventral margins heavily sclerotized, basal and apical thirds somewhat expanded dorsad and ventrad; apex broad, dorsal margin broadly and evenly rounded, ventral margin narrowly rounded.

Transtilla with arm short, stout, well sclerotized, glabrous, approximately one-sixth as long as harpe, broadly separated from and extending subparallel to dorsal margin of costa, terminating subacutely far caudad of basal extremity of harpe.

Uncus obscurely bifid. Dorsal aspect: base rather small, glabrous, entirely set off from tegumen by broad areas of reduced sclerotization, lateral margins heavily sclerotized and converging rather sharply distad into main uncal process; angle of bifurcation minute, acute, located approximately at midpoint of main uncal process; furcae

rather short, well sclerotized, approximate, appearing almost as single process in dried specimens, directed caudad and curving slightly ventrad, lateral margins punctate and setose, apices acute.

Gnathos fused, width medium, slightly elongate, curving ventrocaudad, major mesal portion rather weakly sclerotized (especially toward base); apical portion slightly thickened dorsoventrad, clothed ventrad with minute seta-like processes, dorsal surface scobinate and armed with numerous minute processes; lateral margins very heavily sclerotized, gradually converging distad into evenly rounded apex.

Anellus large, membranous, dorsolateral portions articulating with costal processes of harpes densely clothed with minute seta-like processes, juxta absent.

Aedeagus slender, approximately as long as harpe, cylindrical, asymmetrical, linear in dorsal and ventral aspects, slightly sinuate in lateral aspect; base weakly expanded, emarginate ventrad, opening dorsad, approximate basal fourth curving slightly dorsad; approximate apical third curving somewhat ventrad, slightly expanding distad, broadly opening sinistrad; apex rather broad and very irregular, armed dextrad with rather small, well sclerotized, acute, spinelike process directed dextrad.

Vesica rather large, membranous; small area near apex clothed with numerous, minute, seta-like processes.

TYPE.—Holotype ♂ (type no. 61448) in the U.S. National Museum.

PARATYPES (21 ♂♂, 2 ♀♀).—American Museum of Natural History (2 ♂♂); California Academy of Sciences (1 ♂); Denison University (14 ♂♂, 1 ♀); U.S. National Museum (3 ♂♂, 1 ♀); University of Kansas (1 ♂).

TYPE LOCALITY.—Palmerlee, Cochise Co., Ariz. (date and collector not available).

DISTRIBUTION.—Western United States. Arizona and Utah.

SPECIMENS EXAMINED.—24 (22 ♂♂, 2 ♀♀), from 8 localities:

ARIZONA: Boulder Springs, Mohave Co., 13 ♂♂, ♀ (July 1–15, 1921, 1 ♂ with mite on wing, ♀ with abdomen missing, O. C. Duffner); Chiricahua Mountains, ♂ (July 1–5, 1927, elevation 9000 to 9800 feet, J. A. Kusche); Huachuca Mountains, ♂ (date and collector unknown, this specimen also bears the label, "*Macrotinea anaphorella* Busck, Cotype." Apparently, it was one of a series of specimens representing an unpublished or manuscript species); Hualapai Mountains, ♂ (July 15–30, 1921, O. C. Duffner); Oak Creek Canyon, ♂ (Aug., elevation 6000 feet, abdomen missing, F. H. Snow); Palmerlee, Cochise Co., ♂ (date and collector unknown); Santa Rita Mountains, ♂ (June 19, 1898, E. A. Schwarz); locality and date unknown, ♂, ♀ ("Arizona," Wm. Schaus collection), ♂ ("Ariz., Chas. Palm, Don. 1911."). UTAH: Bluff, San Juan Co., ♂ (Cottonwood Canyon, June 25–July 2, 1933, elevation 4200 feet, A. B. Klots collection).

REMARKS.—This species undoubtedly ranges southward into Mexico. It is not closely related to any of the other acrolophids known to occur in America north of Mexico. In general, *A. parvipalpus* is related to those species having short labial palpi, naked eyes, and laminate antennae covered only dorsad by scales. It may easily be distinguished from the other members of the genus by its unusually short labial palpi and its oddly shaped harpe. The cucullus of the latter structure in *parvipalpus* has its major central portion markedly flattened dorsoventrad so as to appear quite slender in lateral aspect. In addition, the costa of the harpe is produced dorsocaudad into a distinct costal process. The genital structure of this species is quite consistent throughout my series of specimens. The name, *parvipalpus*, refers to the considerably reduced labial palpi exhibited by this species.

43. *Acrolophus davisellus* Beutenmüller

FIGURES 199–201

Acrolophus davisellus Beutenmüller, 1887, Ent. Amer., vol. 3, no. 7, p. 139, Oct.—Smith, 1891, List Lep. Bor. Amer., p. 95, no. 5058.—Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8193.—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 104, no. 9583.

Pseudanaphora davisellus Dyar, 1900, Can. Ent., vol. 32, no. 10, p. 310; 1900, Can. Ent., vol. 32, no. 11, p. 327; 1903, List North Amer. Lep., p. 579, no. 6601.—Barnes & McDunnough, 1912, Can. Ent., vol. 45, no. 12, p. 421.

Beutenmüller's original description follows:

Acrolophus Davisellus—Head and thorax, fuscous, mixed with grayish scales, labial palpi short, ascending, but not recurved over the head and thorax, deep brown outside, and ochreous inside. Primaries, fuscous, irregularly mottled with deep brown patches, forming a sub-lunate dash, running from the disc nearly to the apex, and another patch on the fold about the middle of the wing, below which there is a dirty white space running along the middle third of the internal margin, other dirty white scales scattered over the wings, cilia brown, with pale spots. Secondaries and cilia fuscous. Expanse of wings ♂, 28 mm. ♀, unknown. 1 ♂, Arizona.

The species is allied to *A. arcanella*, Clem. Named in honor of my friend Wm. T. Davis of Staten Island, N.Y., an earnest and closely observing entomologist.

MALE GENITALIA.—Vinculum rather large and well sclerotized, otherwise typical.

Tegumen of medium width, glabrous; lateral arm gradually narrowing to point of articulation with vinculum, margins rather heavily sclerotized, caudal margin weakly sinuate; dorsal area with cephalic margin concave, caudal margin convex and indistinctly fusing with base of uncus.

Harpe simple, but with large ventrobasal development of sacculus. Lateral aspect: costa and sacculus fused, shortened but markedly expanded ventrad and mesad, comprising slightly less than basal three-sevenths of harpe, glabrous except for ventral development of sacculus, broadest near apical extremity, approximate basal half strongly narrowing to acute basal extremity, ental portion of sacculus strongly developed mesad and ventrad into prominent process best seen in ventral aspect; process of sacculus large, broad, well sclerotized, extending as far caudad as apical extremity of sacculus, approximate basal three-fifths fused with sacculus, apical two-fifths free and expanding toward apex, apical fifth rather sparsely punctate, apex with broad and shallow emargination, lateral extremity of apex narrowly rounded, mesal extremity of apex acute. Cucullus somewhat variable, more slender in some specimens than in others, indistinctly fused with costa and sacculus, elongate, slender, base rather weakly punctate, remainder of cucullus becoming more heavily punctate entad and ectad toward apex, approximate apical third heavily setose entad and curving mesad, approximate apical two-thirds curving somewhat ventrad, basal half with margins well sclerotized and parallel, apical half with ventral margin gradually expanded ventrad to give apical third capitate appearance, apex broadly and evenly rounded.

Transtilla with arm well sclerotized, glabrous, approximately one-fourth as long as harpe, basal half divergent from and apical half convergent with dorsal margin of costa, apical fourth curving ventrad beyond basal extremity of harpe, apex acute.

Uncus single, partially and indistinctly separated from tegumen by areas of reduced sclerotization. Dorsal aspect: base large, mesal portion rather weakly sclerotized and glabrous; lateral margins heavily sclerotized, sparsely punctate and setose, sinuate, converging caudad into base of uncal process. Uncal process of medium length, rather robust, heavily sclerotized, curving strongly ventrad, apex subacute.

Gnathos weakly paired, well sclerotized (especially along lateral margins), directed ventrocaudad; arms very short, separated by shallow apical emargination, well sclerotized, rather weakly scobinate dorsad, apices broadly and evenly rounded.

Anellus medium sized, membranous, unarmed, juxta absent.

Aedeagus medium sized, approximately five-sevenths as long as harpe, cylindrical, moderately asymmetrical, sublinear in dorsal and ventral aspects, in lateral aspect basal and apical portions curving ventrad through total arc of approximately 135°; base very broadly expanded laterad and ventrad, flattened, platelike, opening broadly cephalodorsad; central third rather slender, tubular; approximate apical

third somewhat expanded, opening both dextrad and sinistrad, consisting of well sclerotized dorsal and ventral walls; dorsal wall of apical third glabrous, rather slender, narrowing to subacute apex; ventral wall of apical third broader and armed with numerous, small, acute, well sclerotized, spinelike processes directed distad.

Vesica rather small, membranous, unarmed.

TYPE.—Type ♂ (type no. 407) in the U.S. National Museum.

TYPE LOCALITY.—"Arizona."

DISTRIBUTION.—Southwestern United States. Arizona.

SOURCES OF MATERIAL.—American Museum of Natural History (25 ♂♂, 2 ♀♀); California Academy of Sciences (4 ♂♂); Carnegie Museum (2 ♂♂); University of Kansas (1 ♂).

SPECIMENS EXAMINED.—34 (32 ♂♂, 2 ♀♀), from 9 localities:

ARIZONA: Chiricahua Mountains, Cochise Co., 2 ♂♂ (Rustler Park, July 15, 1927, elevation 9000 feet, J. A. Kusche), ♂ (Flys Peak, July 18, 1927, elevation 9000 to 9800 feet, Kusche), ♂ (July 30, 1927, elevation 9000 to 9800 feet, Kusche); Chiricahua National Monument, Cochise Co., ♂, ♀ (July 15, 1948, C. & P. Vaurie); Garces, ♂ (Sept. 12, Biederman); Huachuca Mountains, 8 ♂♂, ♀ (Ramsay Canyon, July 10–15, 1941, one ♂ with mite on abdomen, A. B. Klots); Huachuca Mountains, Cochise Co., ♂ (Ramsay Canyon, July 16, 1948, C. & P. Vaurie); Paradise, Cochise Co., ♂ (Aug., O. C. Poling); Portal, Cochise Co., ♂ (Cave Creek Canyon, July 13, 1948, C. & P. Vaurie); Prescott, Yavapai Co., 14 ♂♂ (July 25, 1948, C. & P. Vaurie); Santa Rita Mountains, ♂ (July, elevation 5000 to 8000 feet, F. H. Snow).

REMARKS.—This is Beutenmüller's only valid species of *Acrolophus* described from America north of Mexico. It undoubtedly ranges southward into Mexico. It is related to those acrolophids having shortened labial palpi, naked eyes, and antennae covered only dorsad or dorsolaterad by scales. *A. davisellus* is very closely related to *serratus*, the two comprising a small species group. As characterized in the key, this group consists of robust species in which the labial palpi are recurved and rather closely appressed to the head, the sacculus of the harpe is developed mesoventrad into a prominent process usually visible in ventral aspect in dried specimens, the gnathos is rather weakly paired and flattened beneath, and the uncus is simple.

A. davisellus may be easily distinguished from its close relative, as well as from the other acrolophids treated here, by its short labial palpi, laminate antennae, color pattern, moderately capitate harpe, and spinose aedeagus. These features are described in more detail in couplet 53 of the key. The genital characters of *davisellus* are consistent throughout my series of specimens.

I have examined the type ♂ specimen at the U.S. National Museum. It is labeled "*Acrolophus davisellus* Beut., type no. 407, Arizona, 339, Through C. V. Riley." This specimen confirms the identity of this species. Contrary to the brief comment accompanying the original

description of *davisellus*, the latter is not at all closely related to *arcanellus*.

Dyar (1900, p. 310) referred to *davisellus* as follows: "Uncus single, long and slender—Though described as an *Acrolophus*, this is obviously referable to *Pseudanaphora*, from the short erect palpi—Fort Grant, Arizona, July 20 (H. G. Hubbard)." In his list of 1903, Dyar also reported this species from Texas, on the basis of his "subspecies," *minor*. However, *minor* is a distinct species. I know of no valid record for *davisellus* outside of Arizona.

44. *Acrolophus serratus*, new species

FIGURES 202–205

MALE.—Head brown. Labial palpi of intermediate length, recurved back over head and extending over anterior margin of thorax, rather narrowly separated from each other, rather heavily clothed with short scales, segmentation clearly visible despite vestiture, basal portions closely appressed to head, apical portions diverging from head and thorax distad, inner surfaces ochreous, outer surfaces heavily suffused with fuscous. Eyes large, protruding, naked, sparsely lashed. Antennae transitional in form between laminate and unipectinate types, ochreous, covered dorsad by brownish scales; segmental processes somewhat flattened laterad but also somewhat thickened transversely, nearly contiguous in basal portions of antennae but becoming progressively more widely spaced from one another toward apical portions of antennae. Forewings with ground color glossy brown, marked with dark brown, pattern variable; markings commonly consisting of small bars or spots along costa, diffused patch at outer end of cell merging with large subtriangular patch on and below center of fold, and large spot on fold near base; outer and posterior margins rather pale, with faint brownish markings. Hindwings glossy brown, fringes slightly lighter. Abdomen brown, basal portions densely overlaid with elongate hairs. Wing expanse: 26 to 30 mm.

FEMALE.—Coloration similar to that of ♂, pattern variable as in ♂. Labial palpi considerably shorter than in ♂, partially recurved back over head and extending well above antennal bases, densely clothed with slender scales, basal portions closely appressed to head and to each other, apical portions diverging from head and from each other distad. Eyes essentially same as those of ♂. Antennae simple, slender, clothed with scales except along ventral surfaces. Wing expanse: 32 to 36 mm.

MALE GENITALIA.—Vinculum typical, as in other species.

Tegumen of medium width, glabrous; lateral arm gradually narrowing to point of articulation with vinculum, margins heavily sclerotized;

dorsal area with cephalic margin emarginate mesad, caudal margin convex and separated from base of uncus by irregular transverse area of reduced sclerotization.

Harpe simple. Lateral aspect: costa and sacculus fused, considerably shortened but somewhat expanded in all aspects, comprising approximate basal three-sevenths of harpe, glabrous except in ventral and ental portions of caudal extremity, broadest in apical third, basal half strongly narrowing to very narrow basal extremity; ventrocaudal margin of sacculus digitate, punctate, setose; caudal margin of sacculus developed strongly entad into prominent, heavily sclerotized, finely dentate process directed caudad. Cucullus only partially separated from costa and sacculus by irregular area of reduced sclerotization, elongate, very slender, approximate apical half curving somewhat ventrad and mesad, margins well sclerotized and subparallel, basal and apical areas slightly expanded, base weakly punctate and setose, remainder of cucullus gradually becoming more heavily punctate and setose entad and ectad toward apex, apex evenly rounded.

Transtilla with arm well sclerotized, glabrous, approximately one-fifth as long as harpe, broadly separated and slightly divergent from dorsal margin of costa, terminating subacutely as far cephalad as basal extremity of harpe.

Uncus single, partially and indistinctly separated from tegumen by areas of reduced sclerotization. Dorsal aspect: base large, subtriangular, large mesal portion weakly sclerotized and glabrous; lateral margins heavily sclerotized, sparsely punctate and setose, linear, converging caudad into base of uncal process. Uncal process rather short, robust, heavily sclerotized, curving strongly ventrad; apex very sparsely punctate and setose, acute.

Gnathos paired, heavily sclerotized (especially along lateral margins), directed ventrocaudad; arms short, broad, closely parallel, scobinate dorsad, apices broadly and bluntly rounded.

Anellus rather small, membranous, unarmed, juxta absent.

Aedeagus somewhat reduced, approximately two-thirds as long as harpe, asymmetrical, sublinear in dorsal and ventral aspects; approximate basal half somewhat expanded, cylindrical; approximate apical half abruptly narrowed, curving ventrad through angle of 45°, opening broadly ventrad and consisting of narrow dorsal strip narrowing to subacute apex; small dorsodextral area near center of apical half armed with approximately six minute, acute, well sclerotized, spinelike processes appearing as serrate dextral margin in dorsal aspect.

Vesica small, elongate, slender, membranous, apparently unarmed.

TYPE.—Holotype ♂ and allotype ♀ in the California Academy of Sciences at San Francisco.

PARATYPES (9 ♂♂, 2 ♀♀).—American Museum of Natural History (2 ♂♂, 1 ♀); California Academy of Sciences (5 ♂♂); U.S. National Museum (1 ♂, 1 ♀); University of Kansas (1 ♂).

TYPE LOCALITY.—Patagonia, Santa Cruz Co., Ariz. (Aug. 1, 1924, E. P. Van Duzee).

DISTRIBUTION.—Southwestern United States. Southern Arizona.

SPECIMENS EXAMINED.—13 (10 ♂♂, 3 ♀♀), from 2 localities:

ARIZONA: Patagonia, Santa Cruz Co., ♂ (Aug. 1, 1924, J. O. Martin), 5 ♂♂, ♀ (Aug. 1, 1924, E. P. Van Duzee), ♂, ♀ (Aug. 2, 1924, Van Duzee), 2 ♂♂, ♀ (July 18, 1948, C. & P. Vaurie); San Bernardino Ranch, Cochise Co., ♂ (Aug., elevation 3750 feet, F. H. Snow).

REMARKS.—This species undoubtedly ranges southward into Mexico. It is closely related to *davisellus*, the two comprising a small species group. *A. serratus* may be distinguished from its close relative, as well as from the other species treated here, on the basis of a number of external and internal features described in detail in the key. In *serratus* the labial palpi are of intermediate length, the antennae are of a type that is transitional between the laminate and unipectinate forms, the color pattern is fairly characteristic and constant, the cucullus of the harpe is very slender and not appreciably capitate, and the apical portion of the aedeagus is weakly dentate or serrate. The genital structure is consistent throughout my series of specimens representing *serratus*. In the *davisellus-serratus* species group, the peculiar mesoventral process of the sacculus may be used both to relate and to separate the two species.

The name, *serratus*, refers to the serrate margin of the aedeagus.

45. *Acrolophus seculatus*, new species

FIGURES 206–207

Female unknown.

MALE.—Similar to *variabilis* in general habitus, but much smaller and more fragile. Head ochreous fringed with white. Labial palpi shortened, fuscous suffused with ochreous, partially recurved over head, partially erect, extending considerably above head, rather narrowly separated from each other, major portions gradually diverging from head distad, each segment heavily clothed with scales developing into prominent tuft along anterior margin, segmentation clearly visible despite vestiture. Eyes large, protruding, naked, sparsely lashed. Antennae simple, ochreous, segments globose; each segment completely encircled by ring of short, brown scales. Forewings brown, marked with dark brown and fuscous, pattern variable; markings commonly consisting of small spots or bars along apical half of costa, suffused patch at outer end of cell merging with larger patch on center of fold, small spot below fold near base, and

pale areas minutely sprinkled with fuscous in apical third and below fold. Hindwings glossy brown, fringes slightly lighter. Abdomen brown. Wing expanse: 13 to 15 mm.

MALE GENITALIA.—Vinculum typical, as in other species.

Tegumen with lateral arm glabrous, broad, evenly narrowing to point of articulation with vinculum, margins sublinear; dorsal area glabrous, broad, fusing into base of uncus.

Harpe simple. Lateral aspect: sublinear, somewhat similar to that of *simulatus*. Costa and sacculus fused, comprising slightly more than basal half of harpe, glabrous except for punctate and setose ventrocaudal margin of sacculus, apical half evenly expanded dorsad and ventrad, basal half extremely slender; ental area from base to apex produced dorsad in form of large, rounded, rather weakly sclerotized expansion extending considerably beyond base of arm of transtilla. Cucullus rather indistinctly fused with costa and sacculus, elongate, slender, heavily punctate, sparsely setose (especially in basal and apical areas), margins sublinear and parallel; apex with ventral portion broadly and evenly rounded, dorsal portion produced somewhat distad and narrowly rounded.

Transtilla with arm glabrous, well sclerotized, approximately one-fourth as long as harpe, diverging considerably from costal margin, apical portion curving strongly ventrad toward costal margin, terminating subacutely somewhat above base of harpe.

Uncus simple. Dorsal aspect: base fused with tegumen; heavily punctate except for narrow, glabrous, mesal area; lateral margins well sclerotized, linear, evenly converging into uncal process. Uncal process distinct from basal area by its greater degree of sclerotization, glabrous, length and width medium, curving caudoventrad, apex acute.

Gnathos fused, short, broad, rather weakly sclerotized, curving almost directly ventrad; apical portion thin, flattened, finely scobinate entad; apex broadly and evenly rounded.

Anellus membranous, unarmed, juxta absent.

Aedeagus elongate, slender, subsymmetrical, glabrous, sublinear in dorsal and ventral aspects, basal half irregularly curving ventrad through angle of approximately 90° in lateral aspect, apical half with some additional ventral curvature; approximate basal fifth slightly expanded, cylindrical; approximate apical four-fifths opening dorsad with aperture becoming gradually wider distad throughout central third of aedeagus and resulting in reduction of apical third to very slender, linear, well sclerotized, ventral strip terminating subacutely.

Vesica membranous, unarmed, slender, extremely elongate, arising dorsad from approximate apical four-fifths of aedeagus but well extruded only from approximate apical half of aedeagus.

TYPE.—Holotype ♂ (type no. 61449) in the U.S. National Museum.

PARATYPES (8 ♂♂).—California Academy of Sciences (1 ♂); U.S. National Museum (7 ♂♂).

TYPE LOCALITY.—Baboquivari Mountains, Pima Co., Ariz. (Aug. 15–30, 1924, O. C. Poling).

DISTRIBUTION.—Southwestern United States. Southern Arizona.

SPECIMENS EXAMINED.—9 (all ♂♂), from 2 localities:

ARIZONA: Baboquivari Mountains, Pima Co., 3 ♂♂ (July 15–30, 1923, elevation 5000 to 7000 feet, O. C. Poling), ♂ (Aug. 1–15, 1923, Poling), 2 ♂♂ (July 1–15, 1924, Poling), 2 ♂♂ (Aug. 15–30, 1924, Poling); Pinal County, "14 miles east of Oracle," ♂ (July 27, 1924, E. P. Van Duzee).

REMARKS.—This species undoubtedly ranges southward into Mexico. Due to the characters selected for the construction of my key, *A. seculatus* is represented there as related to those species having shortened labial palpi, naked eyes, simple antennae with segments encircled by rings of scales, simple uncus, and fused gnathos. However, *seculatus* exhibits so many affinities with the *variabilis-macrophallus-vauriei* species group that it should be considered a fourth member of the latter. This species group, characterized in the key and in the remarks on the following species, *variabilis*, falls within that general series of acrolophids having a type of antenna in which each segment is clothed only dorsad or dorsolaterad with scales. Since each antennal segment of *seculatus* is completely encircled with one ring of scales, this species and its related group emerge at different points in the key.

A. seculatus is probably less closely related to *variabilis*, *vauriei*, and *macrophallus* than are the latter three to one another. In addition to the difference in antennal vestiture mentioned above, *seculatus* may be easily distinguished from its closer relatives on the basis of its considerably smaller size, the shape of its harpe, and its oddly sickle-shaped aedeagus. The various characters of the genitalia are both consistent throughout my small series of *seculatus* and distinct from those of all the other species treated in this work.

Superficially, *seculatus* perhaps most closely resembles *pyramellus* in size and general habitus, although the two may also be separated by external characters. The antennal scales of *seculatus* are short and extend less than half the length of each segment while the antennal scales of *pyramellus* are long and extend more than half the length of each segment. Further, the ventral vestiture of the labial palpi of *seculatus* is heavier and more tuftlike than it is in *pyramellus*.

Among the specimens received from Cornell University is a single ♂ specimen labeled "Sanderson, Texas, May 16, 1918, J. Ch. Bradley" and a microscope slide mount, presumably of its genitalia. Externally, this moth agrees very closely with my series of specimens from Arizona representing *seculatus*. However, the genitalia in the accompanying slide mount, although undoubtedly belonging to *Acrolophus*,

represent an entirely different species with which I am not familiar. Thus, I am in doubt as to the correctness of the association between this specimen and the slide mount of the genitalia. The name refers to the characteristic sickle-shaped aedeagus exhibited by this species.

46. *Acrolophus variabilis* (Walsingham)

FIGURES 208–213

Orthlophus variabilis Walsingham, 1887, Trans. Ent. Soc. London, p. 169, pl. 8, figs. 24, 24a, 24b, 24c, June.—Beutenmüller, 1888, Ent. Amer., vol. 4, no. 2, p. 29.—Smith, 1891, List Lep. Bor. Amer., p. 95, no. 5065.—Dyar, 1900, Can. Ent., vol. 32, no. 10, p. 310; 1900, Can. Ent., vol. 32, no. 11, p. 327; 1903, List North Amer. Lep., p. 579, no. 6598.—Walsingham, 1915, Biol. Centr.-Amer., pt. 12, vol. 4, pp. 378, 385–386.

Acrolophus variabilis Barnes & McDunnough, 1917, Check List Lep. Bor. Amer., p. 191, no. 8188.—Eyer, 1924, Ann. Ent. Soc. Amer., vol. 17, no. 3, p. 315, pl. 35, fig. 4.—McDunnough, 1939, Check List Lep. Can. & U.S. Amer., p. 103, no. 9578.

Walsingham's original description follows:

Orthlophus variabilis—Labial palpi, ♂, erect, not recurved, dirty whitish, more or less tinged with greyish fuscous, with which they are sometimes entirely suffused, about 3½ mm. long, separately tufted on each joint; ♀ porrect, standing out about 2 mm. beyond the head. *Antennae* subochreous; ♂ serrated; ♀ simple. *Head, thorax, and fore wings* dirty whitish, sprinkled and suffused with greyish fuscous, varying with the colour of the fore wings. *Fore wings* elongate, narrow, the costa slightly rounded, apex rounded, apical margin oblique, convex, presenting several varieties of colouring; apical vein not forked. Var. α. dirty whitish, mottled along the apical and costal margins with greyish fuscous; a triangular fuscous patch overlapping the fold, and more or less connected with a spot of the same colour at the end of the cell; fringes mottled alternately greyish fuscous and dirty white both in fore and hind wings. Var. β. greyish fuscous, with scarcely any admixture of whitish scales, the darker fuscous patches distinctly visible, and a few brownish ochreous scales on the disc. Var. γ. pale greyish fuscous, the dark patches almost obsolete, with no admixture of whitish scales, except in the fringes. *Hind wings in all the varieties* brownish, with a slight purplish tinge; the fringes scarcely paler. *Abdomen* pale greyish fuscous; lateral claspers of nearly even width from the base outwards, slightly angulated downwards about their middle, the ends rounded, but more so below than above; uncus single, evenly bent over, but very little longer than its opposing branch coming from beneath it. *Exp. al.* ♂, 24–27 mm.; ♀, 30–34 mm.

I have a considerable series of this species collected by Morrison in Arizona, and had always regarded it as equivalent to *mortipennella*, Gr., the only described species with whitish fore wings and darker hind wings; but Mr. Grote's remark that in his species the labial palpi reach as far back as the dorsum of the thorax proves that it is distinct.

Walsingham's illustrations consisted of: figure 24, the adult ♂ in dorsal aspect (in color); figure 24a, the head of the ♂ in lateral aspect; figure 24b, the head of the ♀ in lateral aspect; and figure 24c, the ♂ genitalia—the uncus, gnathos, and the cucullus of the harpe in lateral aspect and the uncus in dorsal aspect.

MALE GENITALIA.—Vinculum rather large and elongate, retracted well into abdomen in dried specimens.

Tegumen glabrous; lateral arm elongate, very slender at point of articulation with vinculum, gradually expanding dorsocaudad toward dorsal area; dorsal area broad, not separated along meson.

Harpe simple. Lateral aspect: greatly elongated, approximate basal third very slender, central third expanding dorsad and ventrad to about four times width of basal third, approximate apical third narrowed to about half width of central third; costa and sacculus fused, greatly elongate, comprising approximate basal two-thirds to three-fourths of harpe, glabrous except for punctate and setose ventrocaudal margin of sacculus, apical two-fifths evenly expanded dorsad and ventrad, basal three-fifths considerably narrowed, basal extremity acute; cucullus set off from costa and sacculus by ventral constriction and dorsal dentations near base, relatively short, comprising apical one-fourth to one-third of harpe, heavily punctate and setose except for glabrous area near base, base somewhat constricted ventrad and invariably produced dorsad into one to several prominent toothlike processes, dorsal and ventral margins otherwise smooth and subparallel, apex broad and bluntly rounded to subtruncate.

Transtilla with arm elongate, slender, approximately one-third as long as harpe, linear to sublinear, well sclerotized, glabrous, gradually narrowing and diverging from dorsal margin of costa toward apex, terminating subacutely considerably distad of basal extremity of harpe.

Uncus simple. Dorsal aspect: base large, subtriangular, rather indistinctly fused with tegumen, large lateral areas heavily punctate; lateral margins well sclerotized, punctate and setose, sublinear, evenly converging distad into base of uncal process; uncal process rather large, robust, slightly flattened and sparsely setose laterad, gradually narrowing and curving ventrad to narrowly rounded apex.

Gnathos fused mesad into broad, rather weakly sclerotized, glabrous flap directed ventrocaudad; dorsal surface convex, ventral surface concave, lateral margins gradually and evenly converging distad into rather narrowly rounded apex.

Anellus rather elongate, membranous; ventral surface slightly thickened and densely clothed with minute, seta-like projections; juxta absent.

Aedeagus very slender, extremely elongate, half again to twice as long as entire genital capsule, extending far back into abdomen when at rest, cylindrical, asymmetrical, base expanded into small U-shaped pouch, apex expanded dorsolaterad; basal two-thirds to three-fourths slender, linear to sublinear; apical quarter to one-third weakly expanded, curving considerably ventrad. Approximate apical quarter

with laterodextral wall flattened, rather weakly sclerotized, and armed with several series of spines as follows (fig. 212): basal series arising from broader portion of aedeagus and consisting of dense cluster of approximately 15–30 heavily sclerotized, acute, variously sized spines directed and becoming progressively larger distad; central series consisting of single, irregular, dorsal row of several to several dozen smaller, variously sized spines extending from basal cluster almost to apex of aedeagus; apex armed with single, rather small, distinct, well sclerotized, acute spine directed distad.

Vesica small, membranous, bulbous, armed at or near apex with single (rarely two) cornutus; cornutus small, well sclerotized, acute, directed distad.

TYPE.—♂ and ♀ types in the British Museum (Natural History).

TYPE LOCALITY.—"Arizona."

DISTRIBUTION.—Southwestern United States. Kansas and Texas westward to California and southward into Mexico and Central America.

SPECIMENS EXAMINED.—291, from 55 localities. The large number of specimens available for study has made it advisable to reduce the distributional data for this common species largely to the localities and months of occurrence:

ARIZONA: Aguila (Aug.); Baboquivari Mountains ("Kita Peak Rincon," Aug., elevation about 3100 to 4050 feet); Baboquivari Mountains (no date); Badger, Santa Cruz Co. (July); "Bill Wms. Fork" (Aug.); Boulder Springs, Mohave County (July); Chiricahua Mountains (July, elevation 8000 to 9800 feet); Dome (July); Elgin (July); Flagstaff (July); Florence (July), (also, "6 miles south of Florence," July); Fort Huachuca (Aug.); Garces (Aug.); Gila Bend (Aug.); Huachuca Mountains (Ramsay Canyon, July); Hualapai Mountains (July); McNary, White Mountains (July); Oracle (July), (also, "14 miles east of Oracle," July, 1 ♀ with mite on abdomen); Palmerlee (no date); Paradise, Cochise County (Aug.); Patagonia (July, Aug.); Pinal Co., "3 miles west of Magma" (Aug.); San Bernardino Ranch, Cochise Co. (Aug., elevation 3750 feet); San Carlos (July); Santa Catalina Mountains (Pepper Sauce and Sabino Canyons, Aug.); Santa Cruz Co. (Aug.); Santa Rita Mountains (June and July, elevation 5000 to 8000 feet), (Florida Canyon, Aug.), (Santa Rita Experimental Range, July); Superior (Boyce Thompson Arboretum, Aug.); Tombstone (Aug.); Tucson (July, Aug., Oct.), (July, at light, elevation 2400 feet), (St. Xavier National Monument, Tucson, July and Aug., 1♂ unusually small); Tumacacori National Monument, Santa Cruz Co. (July); Wellton (Aug.). CALIFORNIA: Fort Yuma (Aug.); Mountain Springs (Aug.); Palm Springs (Oct.); Rancho La Sierra, Riverside Co. (Aug., Sept.); San Diego (May, July, Aug.). CANADA: One ♂, with genitalia missing, from the California Academy of Sciences, labeled "Ontario, Canada, Aug., 1909, W. G. Palmer collector." This record is extremely questionable. COLORADO: Mesa Verde National Park (July); Paonia (June and July, light trap). KANSAS: Stanton Co. (July, elevation 3000 feet). MEXICO: San Carlos Bay, Gulf of California (July). NEVADA: Pyramid (July). NEW MEXICO: Lordsburg (July); Luna Co., "10 miles east of Deming" (July); Mesquite, near Mesilla Park (July); State College (July). TEXAS: Davis Monument (Aug.); Fort Davis (July); Marathon (July).

REMARKS.—This species is easily the commonest and most widely distributed acrolophid in the southwestern United States. As indicated by the above records, it is especially prevalent in Arizona, the type locality. Besides being one of the older western species, it is also extremely variable in size and coloration. Nevertheless, *variabilis* has no synonyms, at least none from America north of Mexico.

The material representing this species was received on loan from numerous sources. Large series containing both sexes are to be found in the collections of the California Academy of Sciences at San Francisco, the American Museum of Natural History, and Cornell University.

A. variabilis is related to those species having shortened labial palpi, antennae in which each segment is clothed only dorsad or dorsolaterad with scales, simple uncus, and fused gnathos. It is closely related to *seculatus*, *macrophallus*, and *vauriei*, forming with them a distinct species group. As characterized in the key, the *variabilis-seculatus-macrophallus-vauriei* species group consists of rather fragile moths in which the labial palpi are erect instead of appressed to the head; each segment of the palpi is clothed with a prominent tuft of scales along its anterior margin. In addition, this group exhibits a type of gnathos which is fused, concave beneath, and hood-shaped.

A. variabilis may be very easily separated from its close relatives, as well as from all the other acrolophids known to occur in America north of Mexico, on the basis of its distinctive genitalia. Its entire genital capsule is unusually elongate and slender. The dorsal margin of the cucullus of its harpe is prominently emarginate and dentate near the base. Lastly, the apical quarter or third of its aedeagus is heavily armed with a series of variously sized spines. The genital characters are quite consistent throughout my large series of specimens representing *variabilis*.

Mr. Tams of the British Museum (Natural History) has sent photographs labeled "*variabilis* Wals., type" and showing the adult ♂ and ♀ and their respective genitalia. These photographs confirm the identity of this species. In addition, at the U.S. National Museum are various slide preparations of ♂ genitalia, labeled "*variabilis* Wlsm.," agreeing with my concept of this species.

Dyar (1900, p. 310) published a paragraph of distributional data for *variabilis*. Walsingham (1915, p. 386) listed the range of this species as Texas, Colorado, Nevada, California, Arizona, New Mexico, and Central America (Sonora, Mexico—1883, H. K. Morrison).

47. *Acrolophus macrophallus*, new species

FIGURES 214–216

MALE.—Similar to *variabilis* in general habitus, but somewhat smaller. Head pale ochreous. Labial palpi of intermediate length, ochreous suffused with fuscous, erect, extending well above head, basal extremities appressed to head and to each other, major portions well separated from head and from each other, each segment heavily clothed with scales developing into prominent tuft along anterior margin, segmentation clearly visible despite vestiture. Eyes large, protruding, sparsely and finely setose, without lashes. Antennae simple, laminate, ochreous, covered dorsad with scales, segmental processes set closely together throughout antennae. Thorax ochreous fringed with fuscous and white. Forewings brown, marked with dark brown and ochreous, pattern variable; markings commonly consisting of alternate light and dark bars along apical half of costa, ochreous streaks beneath costa and fold, and dark bars in cell and on fold. Hindwings and fringes glossy brown. Abdomen brown. Wing expanse: 17 to 23 mm.

FEMALE.—Coloration similar to that of ♂, pattern variable as in ♂. Labial palpi somewhat shorter than in ♂, directed forward and downward, closely appressed to each other, heavily clothed with scales, segmentation largely obscured by vestiture. Eyes essentially same as those of ♂. Antennae simple, slender, segments entirely encircled by scales. Wing expanse: 22 to 29 mm.

MALE GENITALIA.—Vinculum large, elongate, ventral surface produced considerably caudad.

Tegumen with lateral arm glabrous, greatly elongated, basal half articulating with vinculum very slender, apical half gradually widening caudad; dorsal area of medium width, glabrous, indistinctly fusing with base of uncus.

Harpe simple. Lateral aspect: sublinear, slender, greatly elongated, closest to that of *variabilis*. Costa and sacculus fused, comprising approximate basal two-thirds of harpe, glabrous except for punctate and setose ventrocaudal margin of sacculus, apical third evenly expanded somewhat ventrad and markedly dorsad, central third becoming narrow and attenuated basad, basal third narrow but somewhat expanded dorsad and ventrad slightly before basal extremity, ental area from base to apex produced dorsad in form of weakly sclerotized expansion extending somewhat beyond arm of transtilla and basal two-thirds of costa. Cucullus indistinctly fused with costa and sacculus, rather short and slender, punctate and setose, approximate basal third slender, apical two-thirds gradually and evenly expanding ven-

trad to approximately twice width of narrowest portion of basal third, apex broadly and bluntly rounded.

Transtilla with arm glabrous, well sclerotized, slender, greatly elongated, slightly more than one-third as long as harpe, linear, rather closely subparallel with costal margin of harpe, terminating subacutely somewhat above base of harpe.

Uncus simple. Dorsal aspect: base fused with tegumen and set off only by heavily punctate lateral areas in cephalic half; with elongate, slender, weakly sclerotized, mesal area; lateral margins heavily sclerotized, punctate and setose, sinuate, gradually converging into uncal process. Uncal process distinct from basal area by its greater degree of sclerotization, with lateral margins of basal area sparsely punctate and setose, length and width medium, evenly curving caudoventrad, apex acute.

Gnathos fused, approximately same as that of *vauriei*, broad, length medium, glabrous, curving ventrocaudad, ventral surface slightly concave and broad lateral portions directed strongly downward to give marked hood-shaped appearance; apical portion thin, somewhat upcurved, with lateral margins evenly converging to narrowly rounded apex.

Anellus large, membranous, unarmed, juxta absent.

Aedeagus very long and slender, approximately half again as long as harpe, asymmetrical, glabrous, sublinear in dorsal and ventral aspects, approximate apical two-fifths curving considerably ventrad in lateral aspect; base slightly expanded, with small dorsal opening; approximate basal three-fifths sublinear or sinuate, cylindrical, slightly expanded distad, partially opening dorsad at apical extremity; apical two-fifths abruptly narrowed in lateral aspect to approximately half width of portion immediately basad, considerably flattened dorsoventrad, gradually opening lateroventrad; ventral wall gradually blending with vesica distad, terminating considerably basad of apex; dorsal wall heavily sclerotized and terminating distad in large, acute, heavily sclerotized, spinelike process (wanting in one dissection, possibly through damage) extending beyond vesica.

Vesica elongate; basal portion slender, weakly sclerotized, blending to some extent with apical portions of aedeagus; apical portion irregularly expanding distad, broadest near apex, membranous, extending free beyond apical extremities of aedeagus, curving back toward base of aedeagus through angle of approximately 180°, with numerous transverse infoldings becoming more prominent distad; armed at or near apex with single cornutus and with or without several small, well sclerotized, circular inclusions located at base of cornutus. Cornutus large, approximately same size as spinelike process of aedeagus, well

sclerotized, acute, directed apicad (thus, toward base of aedeagus), extending to or beyond apex of vesica.

TYPE.—Holotype ♂ and allotype ♀ (type no. 61450) in the U.S. National Museum.

PARATYPES (17 ♂♂, 1 ♀).—American Museum of Natural History (6 ♂♂); California Academy of Sciences (4 ♂♂); Carnegie Museum (1 ♂); U.S. National Museum (5 ♂♂, 1 ♀); University of Kansas (1 ♂).

TYPE LOCALITY.—"Southern Arizona" (exact locality, date, and collector not available).

DISTRIBUTION.—Southwestern United States. Arizona and (?) New Mexico.

SPECIMENS EXAMINED.—50 (19 ♂♂, 31 ♀♀), from 12 localities (1 ♂ without data):

ARIZONA: "Babaquivera" Mountains, Pima Co., ♀ (date and collector unknown); Baboquivari Mountains, Pima Co., 4 ♂♂ (July 15–30, 1923, elevation 5000 to 7000 feet, O. C. Poling), ♂ (Sept. 1–15, 1923, Poling); Paradise, Cochise Co., ♂ (June, O. C. Poling); Pinal Co., "3 miles west of Magna," ♂ (Aug. 18, 1924, E. P. Van Duzee); San Bernardino Ranch, Douglas, Cochise Co., ♂ (Aug., elevation 3750 feet, F. H. Snow); "Southern Arizona," ♂, ♀ (date and collector unknown); Superior, Pinal Co., 6 ♂♂ (Boyce Thompson Arboretum, Aug. 1–2, 1937, A. B. Klots); Tucson, Pima Co., 3 ♂♂ (St. Xavier National Monument, Aug. 12, 1924, J. O. Martin).

The following series of 29 ♀♀ has been tentatively associated with *macrophallus*. I had originally placed them with the ♀♀ of the allied species, *variabilis*, which they closely resemble. In addition, the data labels are identical for numerous ♀♀ of both species. However, the ♀♀ listed below differ somewhat from those of *variabilis* and they seem more likely to belong to *macrophallus*, despite the fact that none of the data labels are identical between the two sexes in the resulting series representing *macrophallus*. The ♀♀ far outnumber the ♂♂, an unusual situation among acrolophids. For these reasons the association is rather questionable and the 29 ♀♀ are not to be considered paratypes. The sources of these specimens are: American Museum of Natural History (7 ♀♀); California Academy of Sciences (14 ♀♀); Carnegie Museum (3 ♀♀); Cornell University (1 ♀); New Mexico College of Agriculture and Mechanic Arts (1 ♀); University of Kansas (3 ♀♀).

ARIZONA: Baboquivari Mountains, 4 ♀♀ (no date, one specimen with mite on abdomen, F. H. Snow); Huachuca Mountains, ♀ (Ramsay Canyon, July 10–15, 1941, A. B. Klots); Oracle, Pinal Co., 4 ♀♀ (July 28, 1924, J. O. Martin), 9 ♀♀ ("14 miles east of Oracle," July 24 and 27, 1924, one specimen with mite on abdomen, E. P. Van Duzee and J. O. Martin); Palmerlee, Cochise Co., ♀ (date and collector unknown); Pinal Co., "6 miles south of Florence," ♀ (July 23, 1924, E. P. Van Duzee); San Bernardino Ranch, Cochise Co., ♀ (Aug., elevation 3750 feet, F. H. Snow); Tucson, 2 ♀♀ (July 30, 1937, A. B. Klots), ♀ (Oct. 8–10, 1939, Crandall), 4 ♀♀ (July 13–14 and 30, 1943, Fred H. Rindge collection). NEW MEXICO: State College, Dona Ana Co., ♀ (July 8, 1945).

REMARKS.—This species has been recorded almost exclusively from southern Arizona. It undoubtedly ranges southward into Mexico. *A. macrophallus* is closely related to *variabilis*, *seculatus*, and *vauriei*, forming with them a distinct species group. The members of this group are bound together by similarities of cephalic structures, general habitus, and genital structures. The group has been characterized in the key and in the foregoing remarks on *variabilis*.

A. macrophallus may be easily separated from its close relatives, as well as from the other acrolophids treated here, on the basis of its genitalia. As in *variabilis*, its entire genital capsule is markedly elongate. The aedeagus of *macrophallus* is extremely elongate. In dried specimens, this organ is invariably extruded from the tip of the abdomen, while its basal extremity commonly extends as far back into the moth as the second abdominal segment. The vesica of the aedeagus is armed at or near its apex with a large cornutus. The genital characters are consistent throughout my series of specimens representing *macrophallus*. The name is descriptive of the extremely elongate aedeagus exhibited by this species.

48. *Acrolophus vauriei*, new species

FIGURES 217–219

MALE.—Somewhat similar to *variabilis* in general habitus. Head white sprinkled with fuscous. Labial palpi of intermediate length, fuscous contrastingly suffused with white, erect, extending considerably above head, basal extremities appressed to head and to each other, major portions well separated from head and from each other, each segment heavily clothed with scales developing into prominent tuft along anterior margin, segmentation clearly visible despite vestiture. Eyes large, protruding, naked or with several minute setae, without lashes. Antennae simple, laminate, ochreous, covered dorsad with brown and fuscous scales, segmental processes set closely together throughout antennae. Thorax white suffused with fuscous. Forewings fuscous heavily suffused with contrasting grayish white, pattern somewhat variable; markings in form of alternating light and dark bars along fringe and apical half of costa, dark patch at outer end of cell bordered on either side by grayish-white area, and dark patch beneath center of fold bordered by grayish-white area extending from fold to posterior margin. Hindwings brown, fringes contrastingly grayish-white streaked with brown. Abdomen dull brown. Wing expanse: 19 to 21 mm.

FEMALE.—Coloration similar to that of ♂, but pattern less contrasting. Labial palpi slightly shorter than in ♂, porrect, rather closely appressed to each other, heavily clothed with scales, segmenta-

tion partially obscured by vestiture. Eyes essentially same as those of ♂. Antennae simple, slender, segments largely covered by scales. Wing expanse: 21 mm.

MALE GENITALIA.—Vinculum typical, as in other species.

Tegumen with lateral arm glabrous, of medium width, rather elongate, narrowing somewhat to point of articulation with vinculum; dorsal area glabrous, of medium width, indistinctly fusing with base of uncus.

Harpe simple. Lateral aspect: sublinear, quite similar to that of *seculatus*. Costa and sacculus fused, comprising somewhat more than basal half of harpe, glabrous except for punctate and setose ventrocaudal margin of sacculus, apical half evenly expanded ventrad, basal half slender and sinuate; ental area from base to near apex produced dorsad in form of smoothly rounded, weakly sclerotized expansion extending well beyond base of arm of transtilla. Cucullus indistinctly fused with costa and sacculus, elongate, slender, very heavily punctate ectad and entad, sparsely setose in basal and apical areas, basal two-thirds with margins sublinear and subparallel, apical third somewhat expanded dorsad; apex with ventral margin broadly and evenly rounded, dorsal margin produced slightly distad and very narrowly rounded.

Transtilla with arm glabrous, well sclerotized, approximately one-fourth as long as harpe, linear except for extreme apex curving ventrad and ectad, subparallel with costal margin, terminating subacutely somewhat above base of harpe.

Uncus simple. Dorsal aspect: base fused with tegumen and set off only by heavily punctate lateral and mesal areas in basal half; lateral margins heavily sclerotized, punctate and setose, sublinear, evenly converging into uncal process. Uncal process distinct from basal area by its greater degree of sclerotization, lateral margins sparsely punctate and setose at base, length and width medium, evenly curving caudoventrad, apex subacute.

Gnathos fused, broad, of medium length, glabrous, curving ventrocaudad, ventral surface slightly concave and lateral margins directed strongly downward to give hood-shaped appearance; apical portion thin, somewhat upcurved, subtriangular, apex narrowly rounded.

Anellus membranous, unarmed, juxta absent.

Aedeagus slender, elongate, approximately as long as harpe, cylindrical, asymmetrical, glabrous, sublinear and somewhat sinuate in dorsal and ventral aspects, basal and apical thirds curving somewhat ventrad in lateral aspect, base slightly expanded dorsad, approximate apical third opening dorsad; apex terminating ventrad in short, robust, heavily sclerotized, acute, spinelike process; apex terminating

dorsad in several elongate, slender, weakly sclerotized areas blending with membrane of vesica.

Vesica membranous, elongate, slender, armed at apex with two cornuti. A third extremely minute cornutus may occur ventrad between the two larger ones. These cornuti are rather indistinctly associated with the weakly sclerotized dorsal areas of the apex of the aedeagus, and thus might be considered as armature of the latter. However, they are fairly flexible and seem to be more closely associated with the vesica. Cornuti: one located at extreme apex of vesica, other with apex just reaching base of first cornutus; small, approximately equal in size, well sclerotized, acute, directed distad.

TYPE.—Holotype ♂ in the American Museum of Natural History at New York City.

PARATYPES (2 ♂♂, 1 ♀).—American Museum of Natural History (1 ♂, 1 ♀); U.S. National Museum (1 ♂).

TYPE LOCALITY.—Terlingua, Brewster Co., Tex. (July 3, 1948, C. & P. Vaurie).

DISTRIBUTION.—Southwestern United States. Southwestern Texas.

SPECIMENS EXAMINED.—4 (3 ♂♂, 1 ♀), from 2 localities:

TEXAS: Fort Davis, Jeff Davis Co., ♂, ♀ (July 2, 1948 C. and P. Vaurie); Terlingua, Brewster Co., 2 ♂♂ (July 3, 1948, C. and P. Vaurie).

REMARKS.—This species undoubtedly ranges southward into Mexico. It is apparently quite rare in collections. *A. vauriei* is closely related to *variabilis*, *seculatus*, and *macrophallus*, forming with them a distinct species group. This group has been characterized in the key and in the foregoing remarks on *variabilis*.

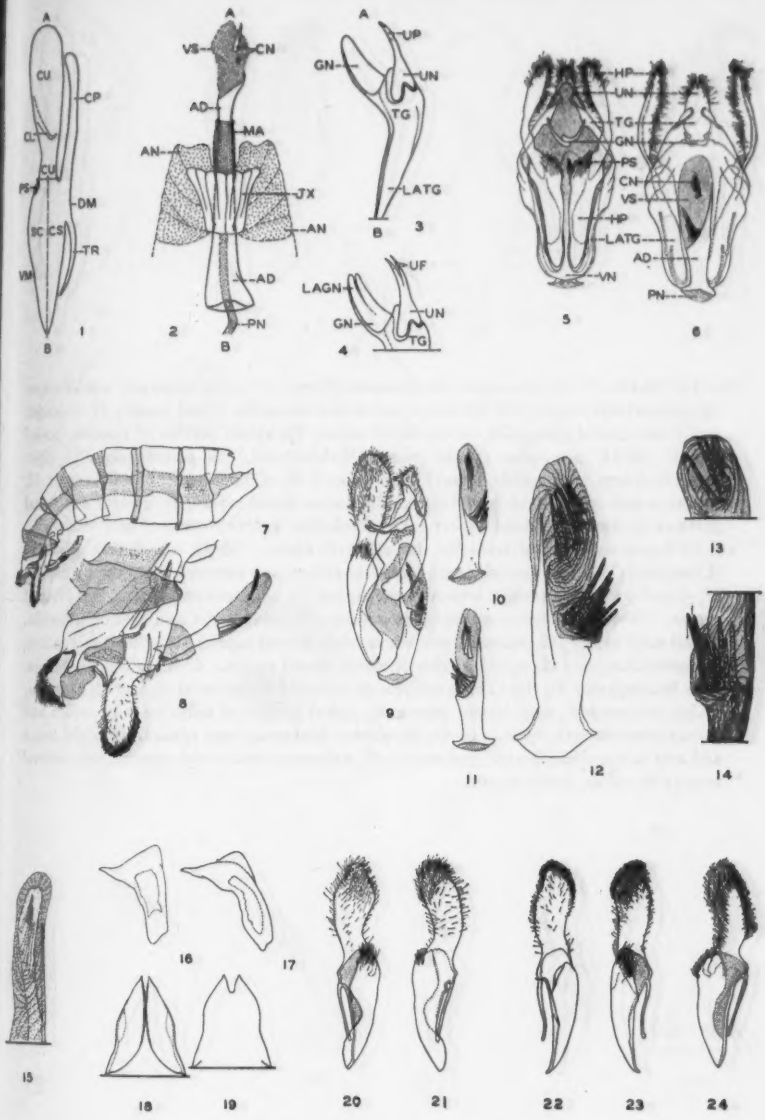
A. vauriei may be separated from its close relatives, as well as from the other species treated here, on the basis of its genital structure. Its aedeagus is not greatly elongated and it does not tend to extrude from dried specimens. The vesica of this organ is armed at its apex with two or three small cornuti.

This species is named in honor of its collectors, Charles and Patricia Vaurie.

FIGURES 1–24.—1–4, Hypothetical male genital structures in *Acrolophus:* 1, right harpe and associated structures, lateral ectal aspect; 2, aedeagus and associated structures, ventral aspect; 3, tegumen and associated structures, dorsolateral aspect; 4, bifurcate uncus and paired gnathos, dorsolateral aspect. 5–24, *Acrolophus popeanellus* (Clemens): 5, 6, entire male genital capsule: 5, ventral aspect; 6, dorsal aspect. 7, Male abdomen with genitalia extruded, lateral aspect. 8, Extruded male genitalia, lateral aspect. 9, Male genitalia with vinculum and right harpe removed, lateral aspect. 10, Aedeagus, vesica, and clusters of cornuti, ventral aspect. 11, Aedeagus, vesica, and clusters of cornuti, dorsal aspect. 12, aedeagus, vesica, and cornuti, ventral aspect. 13, Apical portion of vesica with apical cluster of cornuti. 14, Basal portion of vesica with basal cluster of cornuti. 15, Apical half of vesica with series of cornuti visible beneath apical extension of aedeagus, dorsal aspect. 16–19, uncus: 16, lateral aspect of specimen 1; 17, lateral aspect of specimen 2; 18, dorsal aspect of specimen 1; 19, outline, dorsal aspect of specimen 2. 20, 21, Right harpe and arm of transtilla: 20, lateral ental aspect of specimen 1; 21, lateral ectal aspect of specimen 1. 22, 23, Left harpe and arm of transtilla: 22, lateral ectal aspect of specimen 2; 23, lateral ental aspect of specimen 2; 24, right harpe and arm of transtilla, lateral ectal aspect of specimen 3.

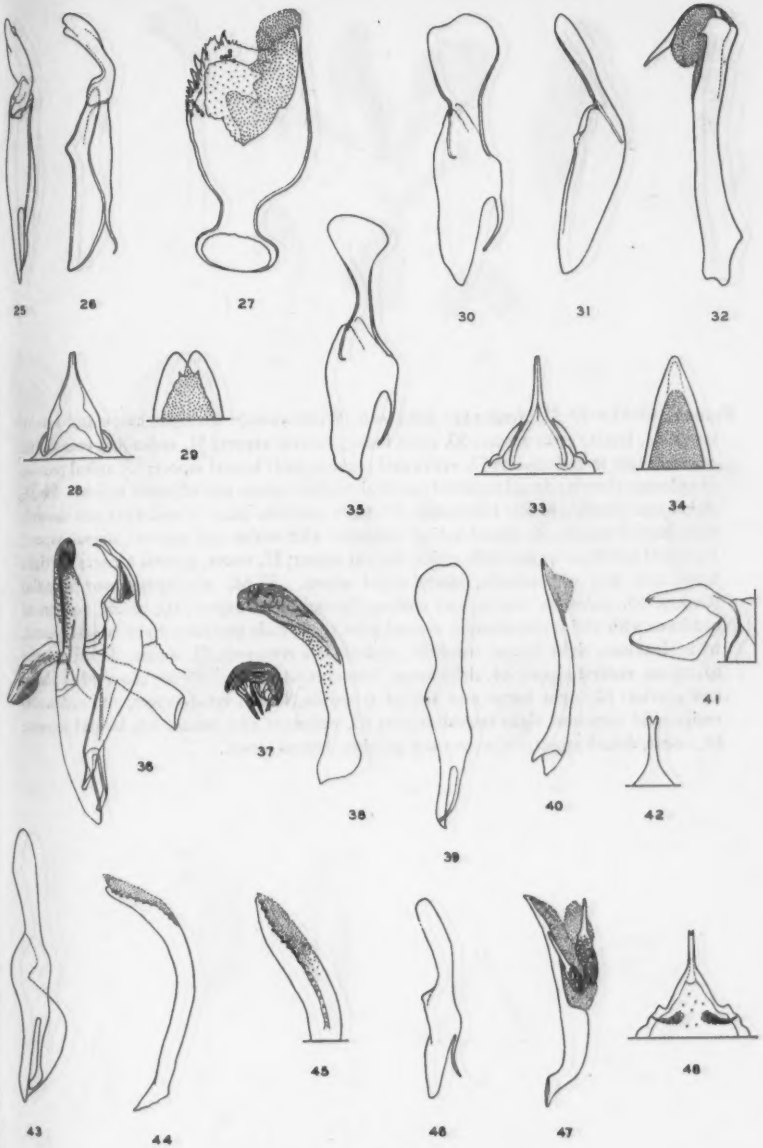
ABBREVIATIONS APPLIED TO THE MALE GENITALIA

A—apex.
AD—aedeagus.
AN—anellus.
B—base.
CL—clasper (on ental surface) of cucullus.
CN—cornutus (cornuti).
CP—dorsal process of costa=costal process or dorsal process.
CS—costa of harpe.
CU—cucullus of harpe.
DM—dorsal margin.
GN—gnathos.
HP—harpe.
JX—juxta.
LAGN—lateral arm of gnathos.
LATG—lateral arm of tegumen.
MA—manica, uniting anellus and aedeagus.
PN—penis.
PS—punctate, setose area near ventrocaudal extremity of sacculus.
SC—sacculus of harpe.
TG—tegumen.
TR—arm of transtilla.
UF—furcae of uncus.
UN—uncus.
UP—uncal process.
VM—ventral margin.
VN—vinculum.
VS—vesica.



For Explanation See Opposite Page.

FIGURES 25–48.—25–29, *Acrolophus dorsimaculus* (Dyar): 25, right harpe and arm of transtilla, lateral ectal aspect; 26, left harpe and arm of transtilla, dorsal aspect; 27, aedeagus and vesica, dorsal aspect; 28, uncus, dorsal aspect; 29, apical portion of gnathos, dorsal aspect. 30–34, *Acrolophus griseus griseus* (Walsingham), new combination: 30, right harpe and arm of transtilla, lateral ectal aspect; 31, right harpe, ventral aspect; 32, aedeagus and vesica, right lateral aspect; 33, uncus, dorsal aspect; 34, central and apical portions of gnathos, dorsal aspect. 35, *Acrolophus griseus capitatus*, new subspecies, right harpe and arm of transtilla, lateral ectal aspect. 36–38, *Acrolophus texanellus* (Chambers): 36, male genitalia with vinculum and anellus removed, right lateral aspect; 37, dorsal portion of anellus, lateroventral aspect; 38, aedeagus and vesica, right lateral aspect. 39–42, *Acrolophus acornus*, new species: 39, right harpe and arm of transtilla, lateral ectal aspect; 40, aedeagus and vesica, right lateral aspect; 41, uncus and gnathos, dorsolateral aspect; 42, apical portion of uncus, dorsal aspect. 43–45, *Acrolophus simulatus* Walsingham: 43, right harpe and arm of transtilla, lateral ectal aspect; 44, aedeagus, vesica, and cornuti, right lateral aspect; 45, apical portion of aedeagus with vesica and cornuti, dorsolateral aspect. 46–48, *Acrolophus bicornutus*, new species: 46, right harpe and arm of transtilla, lateral ectal aspect; 47, aedeagus, vesica, and cornuti, right lateral aspect; 48, uncus, dorsal aspect.



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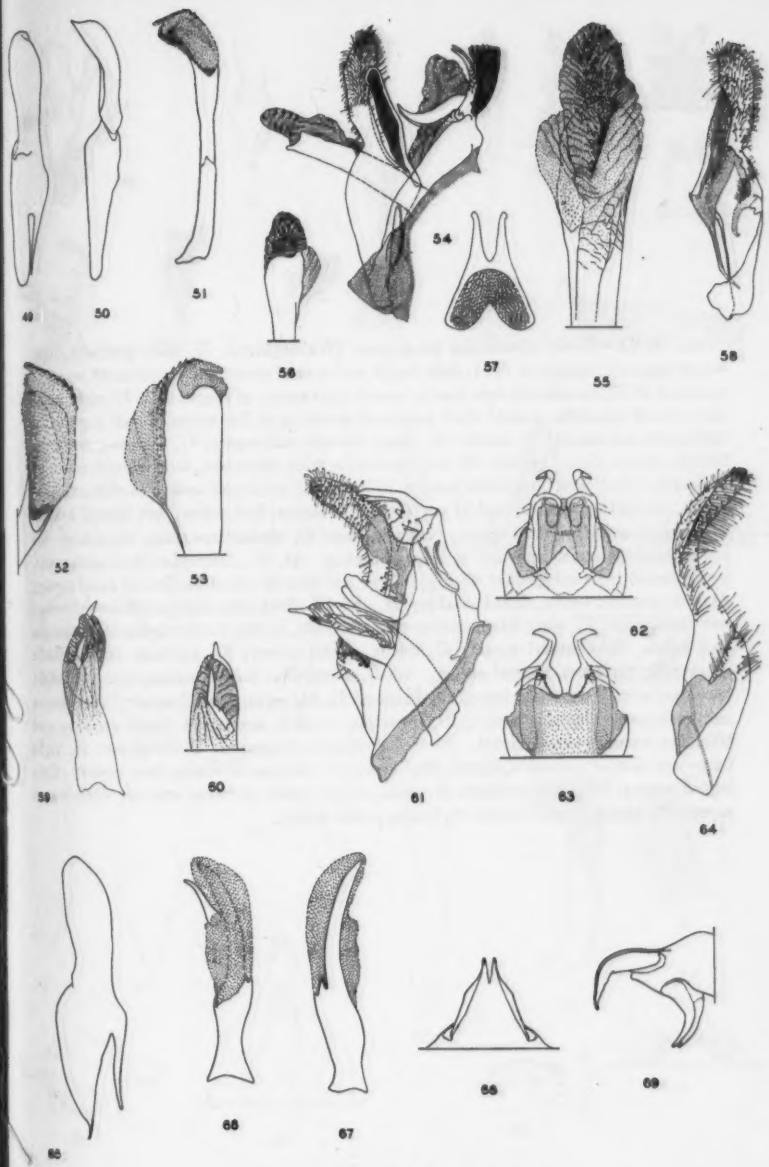
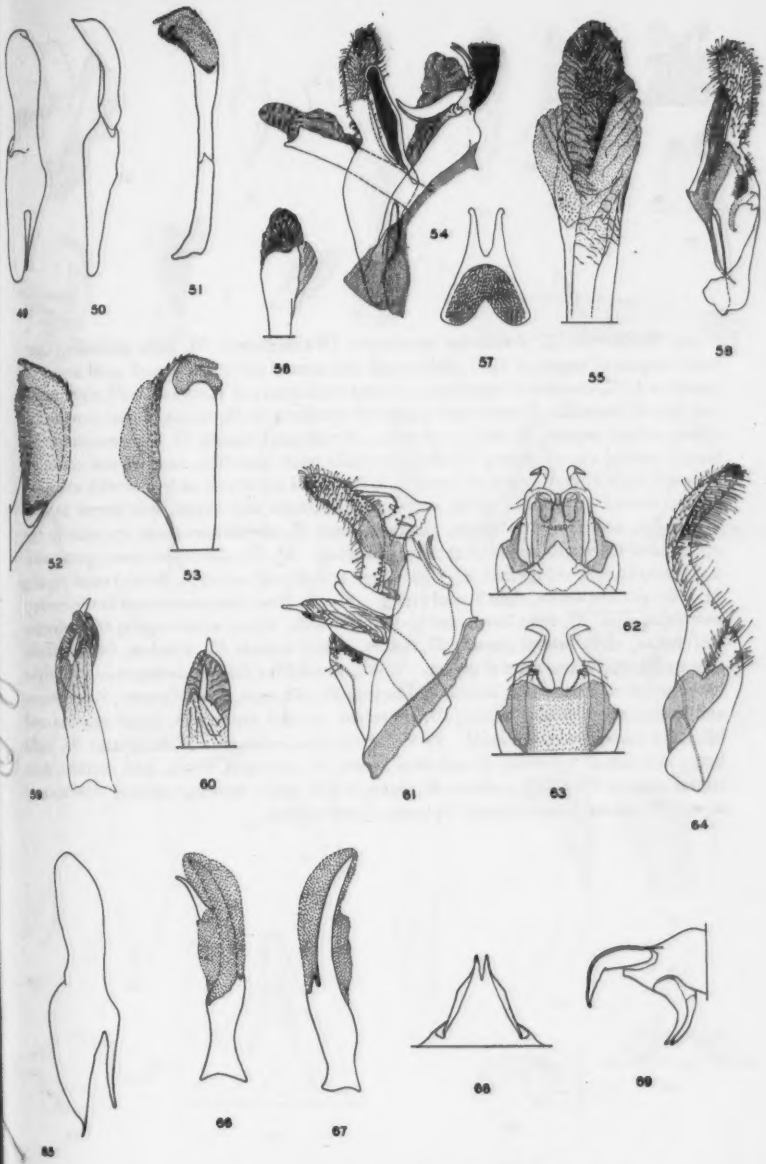
FIGURES 49–69.—49–53, *Acrolophus filicicornis* (Walsingham): 49, right harpe and arm of transtilla, lateral ectal aspect; 50, right harpe, ventral aspect; 51, aedeagus, vesica, and cornuti, right lateral aspect; 52, vesica and cornuti, right lateral aspect; 53, apical portion of aedeagus showing dorsal aspect of terminal process, spines, and adjacent vesica. 54–58, *Acrolophus plumifrontellus* (Clemens): 54, male genitalia (base of aedeagus not shown), right lateral aspect; 55, apical half of aedeagus with vesica and cornuti, dorsal aspect; 56, apical half of aedeagus with vesica, ventral aspect; 57, uncus, ventral aspect; 58, right harpe and arm of transtilla, lateral ental aspect. 59–64, *Acrolophus mortipennellus* (Grote): 59, aedeagus, vesica, and cornuti, lateroventral aspect; 60, apical portion of aedeagus with vesica and cornuti, ventral aspect; 61, male genitalia, right lateral aspect, with vinculum, right harpe, transtilla, and anellus removed; 62, uncus, dorsal aspect; 63, uncus, ventral aspect; 64, right harpe, lateral ental aspect. 65–69, *Acrolophus klotsi*, new species: 65, right harpe and arm of transtilla, lateral ectal aspect; 66, aedeagus, vesica, and cornutus, right lateral aspect; 67, aedeagus and vesica, left lateral aspect; 68, uncus, dorsal aspect; 69, uncus and gnathos, lateral aspect.



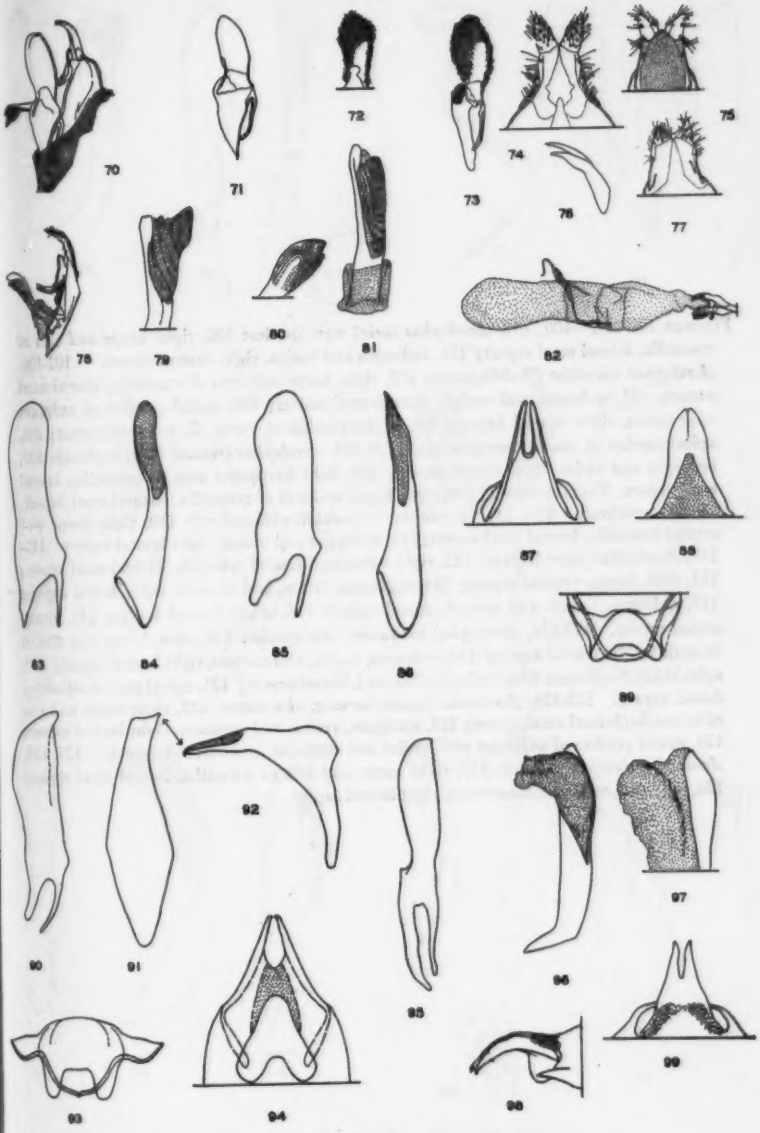
For Explanation See Opposite Page.

FIGURES 49–69.—49–53, *Acrolophus filicicornis* (Walsingham): 49, right harpe and arm of transtilla, lateral ectal aspect; 50, right harpe, ventral aspect; 51, aedeagus, vesica, and cornuti, right lateral aspect; 52, vesica and cornuti, right lateral aspect; 53, apical portion of aedeagus showing dorsal aspect of terminal process, spines, and adjacent vesica. 54–58, *Acrolophus plumifrontellus* (Clemens): 54, male genitalia (base of aedeagus not shown), right lateral aspect; 55, apical half of aedeagus with vesica and cornuti, dorsal aspect; 56, apical half of aedeagus with vesica, ventral aspect; 57, uncus, ventral aspect; 58, right harpe and arm of transtilla, lateral ental aspect. 59–64, *Acrolophus mortipennellus* (Grote): 59, aedeagus, vesica, and cornuti, lateroventral aspect; 60, apical portion of aedeagus with vesica and cornuti, ventral aspect; 61, male genitalia, right lateral aspect, with vinculum, right harpe, transtilla, and anellus removed; 62, uncus, dorsal aspect; 63, uncus, ventral aspect; 64, right harpe, lateral ental aspect. 65–69, *Acrolophus klotsi*, new species: 65, right harpe and arm of transtilla, lateral ectal aspect; 66, aedeagus, vesica, and cornutus, right lateral aspect; 67, aedeagus and vesica, left lateral aspect; 68, uncus, dorsal aspect; 69, uncus and gnathos, lateral aspect.



For Explanation See Opposite Page.

FIGURES 70–99.—70–82, *Acrolophus propinquus* (Walsingham): 70, male genitalia, right lateral aspect of specimen 1; 71, right harpe and arm of transtilla, lateral ectal aspect of specimen 2; 72, cucullus of right harpe, lateral ectal aspect of specimen 3; 73, right harpe and arm of transtilla, lateral ectal aspect of specimen 4; 74, uncus, dorsal aspect; 75, uncus, ventral aspect; 76, outline of uncus, dorsolateral aspect; 77, asymmetrically bifurcate uncus, dorsal aspect; 78, male genitalia with vinculum, harpes, and transtilla removed, right lateral aspect of specimen 2; 79, apical portion of aedeagus with extruded vesica, ventral aspect; 80, apical portions of aedeagus and vesica, left lateral aspect; 81, anellus, aedeagus, and vesica, ventral aspect; 82, membranous sac, apparently the sealed hind-intestine, extruded through the anus. 83, 84, *Acrolophus macrogaster unipectinicornus*, new subspecies: 83, right harpe and arm of transtilla, lateral ectal aspect; 84, aedeagus and vesica, right lateral aspect. 85–89, *Acrolophus macrogaster laminicornus*, new subspecies: 85, right harpe and arm of transtilla, lateral ectal aspect; 86, aedeagus and vesica, right lateral aspect; 87, uncus, dorsal aspect; 88, gnathos, dorsocephalic aspect; 89, vinculum, ventral aspect. 90–94, *Acrolophus baldufi*, new species: 90, right harpe and arm of transtilla, lateral ectal aspect; 91, aedeagus, ventral aspect; 92, aedeagus and vesica, right lateral aspect; 93, vinculum, ventral aspect; 94, fused gnathos and bifurcate uncus, ventral aspect. 95–99, *Acrolophus arizonellus* Walsingham: 95, right harpe and arm of transtilla, lateral ectal aspect; 96, aedeagus, vesica, and cornuti, right lateral aspect; 97, apical portions of aedeagus and vesica showing cornuti, dorsolateral aspect; 98, uncus, lateral aspect; 99, uncus, dorsal aspect.



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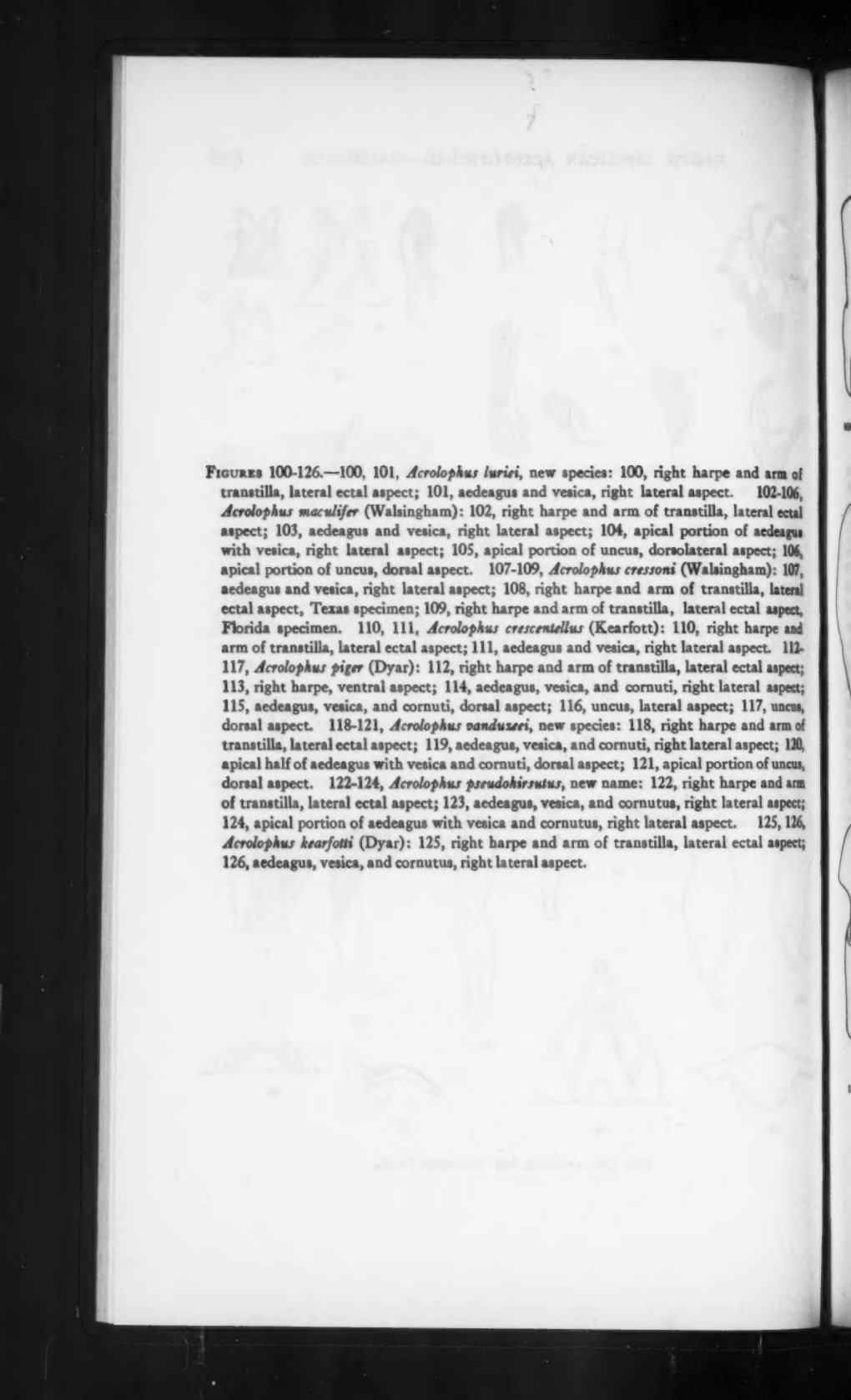
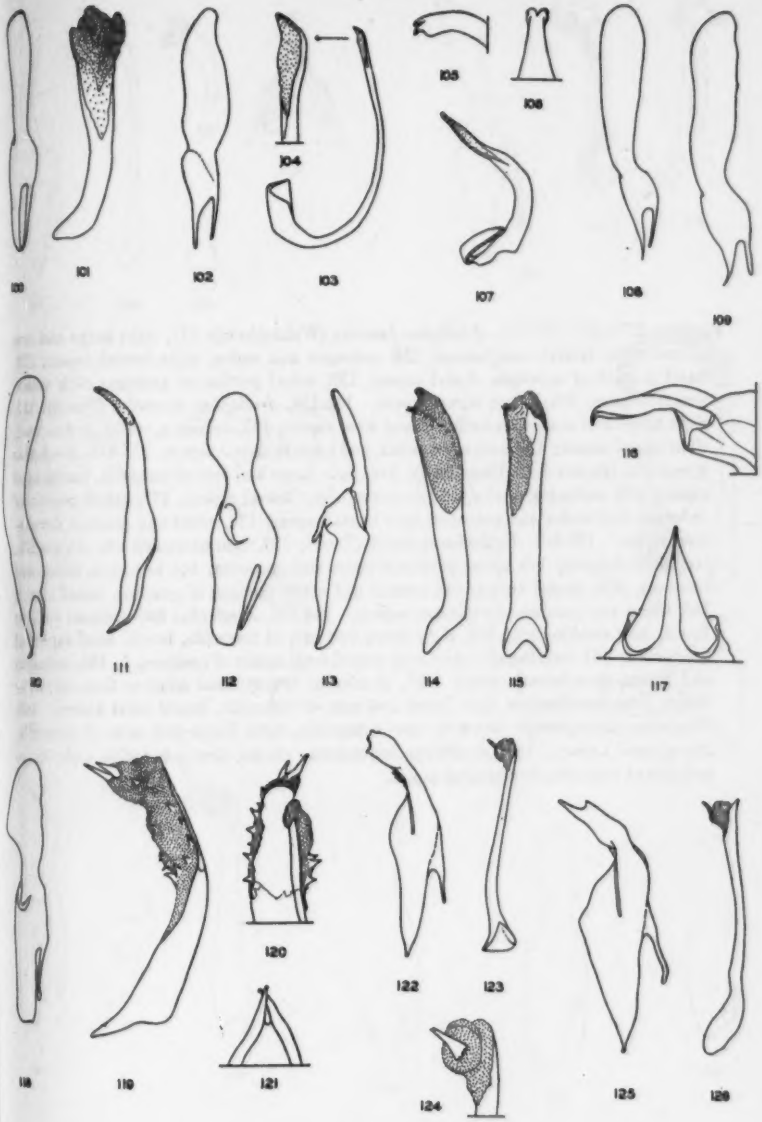
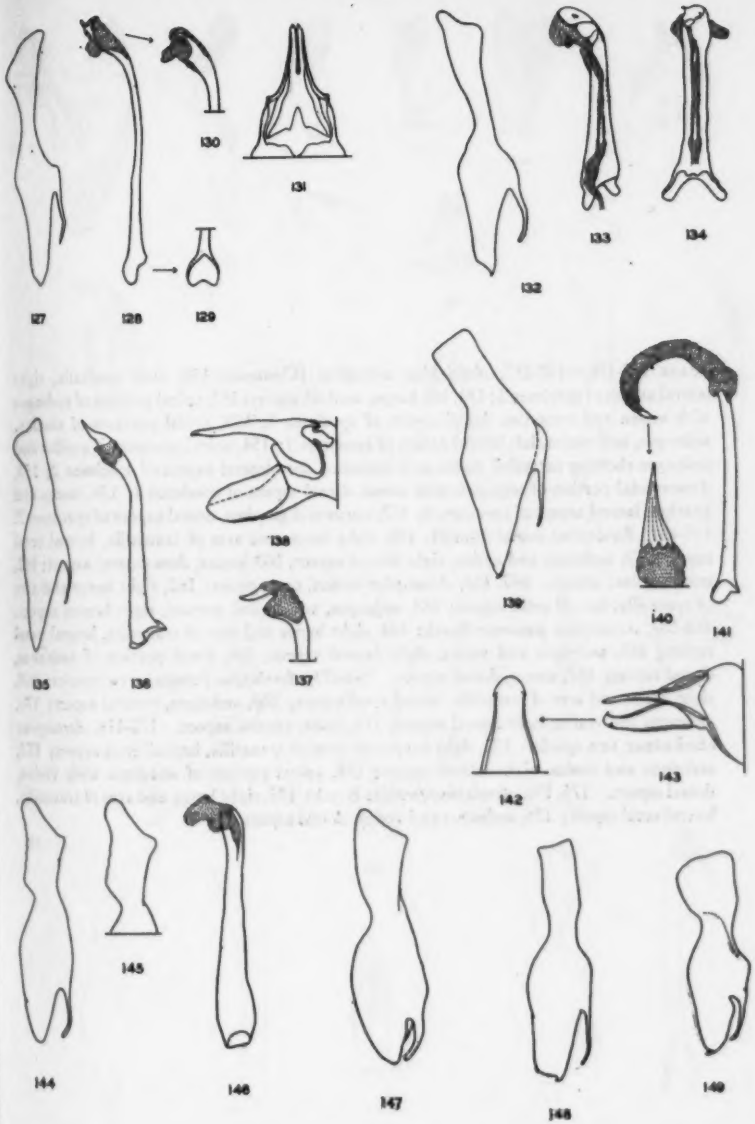


FIGURES 100-126.—100, 101, *Acrolophus luriei*, new species: 100, right harpe and arm of transtilla, lateral ectal aspect; 101, aedeagus and vesica, right lateral aspect. 102-106, *Acrolophus maculifer* (Walsingham): 102, right harpe and arm of transtilla, lateral ectal aspect; 103, aedeagus and vesica, right lateral aspect; 104, apical portion of aedeagus with vesica, right lateral aspect; 105, apical portion of uncus, dorsolateral aspect; 106, apical portion of uncus, dorsal aspect. 107-109, *Acrolophus cressoni* (Walsingham): 107, aedeagus and vesica, right lateral aspect; 108, right harpe and arm of transtilla, lateral ectal aspect, Texas specimen; 109, right harpe and arm of transtilla, lateral ectal aspect, Florida specimen. 110, 111, *Acrolophus crescentellus* (Kearfott): 110, right harpe and arm of transtilla, lateral ectal aspect; 111, aedeagus and vesica, right lateral aspect. 112-117, *Acrolophus piger* (Dyar): 112, right harpe and arm of transtilla, lateral ectal aspect; 113, right harpe, ventral aspect; 114, aedeagus, vesica, and cornuti, right lateral aspect; 115, aedeagus, vesica, and cornuti, dorsal aspect; 116, uncus, lateral aspect; 117, uncus, dorsal aspect. 118-121, *Acrolophus vanduzei*, new species: 118, right harpe and arm of transtilla, lateral ectal aspect; 119, aedeagus, vesica, and cornuti, right lateral aspect; 120, apical half of aedeagus with vesica and cornuti, dorsal aspect; 121, apical portion of uncus, dorsal aspect. 122-124, *Acrolophus pseudohirsutus*, new name: 122, right harpe and arm of transtilla, lateral ectal aspect; 123, aedeagus, vesica, and cornutus, right lateral aspect; 124, apical portion of aedeagus with vesica and cornutus, right lateral aspect. 125, 126, *Acrolophus kearfotti* (Dyar): 125, right harpe and arm of transtilla, lateral ectal aspect; 126, aedeagus, vesica, and cornutus, right lateral aspect.



FOR EXPLANATION SEE OPPOSITE PAGE.

FIGURES 127-149.—127-131, *Acrolophus furcatus* (Walsingham): 127, right harpe and arm of transtilla, lateral ectal aspect; 128, aedeagus and vesica, right lateral aspect; 129, basal portion of aedeagus, dorsal aspect; 130, apical portion of aedeagus with vesica, ventral aspect; 131, uncus, dorsal aspect. 132-134, *Acrolophus punctellus* (Busck): 132, right harpe and arm of transtilla, lateral ectal aspect; 133, aedeagus, vesica, and cornuti, right lateral aspect; 134, aedeagus, vesica, and cornuti, dorsal aspect. 135-138, *Acrolophus pyramellus* (Barnes & McDunnough): 135, right harpe and arm of transtilla, lateral ectal aspect; 136, aedeagus, vesica, and cornutus, right lateral aspect; 137, apical portion of aedeagus with vesica and cornutus, right lateral aspect; 138, uncus and gnathos, dorsolateral aspect. 139-143, *Acrolophus cockerelli* (Dyar): 139, right harpe and arm of transtilla, lateral ectal aspect; 140, apical portion of vesica with cornutus; 141, aedeagus, vesica, and cornutus, right lateral aspect; 142, central and apical portions of gnathos, dorsal aspect; 143, uncus and gnathos, dorsolateral aspect. 144-146, *Acrolophus laticapitanus occidens* Busck, new combination: 144, right harpe and arm of transtilla, lateral ectal aspect of specimen 1; 145, cucullus of right harpe, lateral ectal aspect of specimen 2; 146, aedeagus and vesica, dorsolateral aspect. 147, *Acrolophus laticapitanus occidens* form *leopardus* Busck, new combination, right harpe and arm of transtilla, lateral ectal aspect. 148, *Acrolophus laticapitanus heinrichi*, new subspecies, right harpe and arm of transtilla, lateral ectal aspect. 149, *Acrolophus laticapitanus clarkei*, new subspecies, right harpe and arm of transtilla, lateral ectal aspect.



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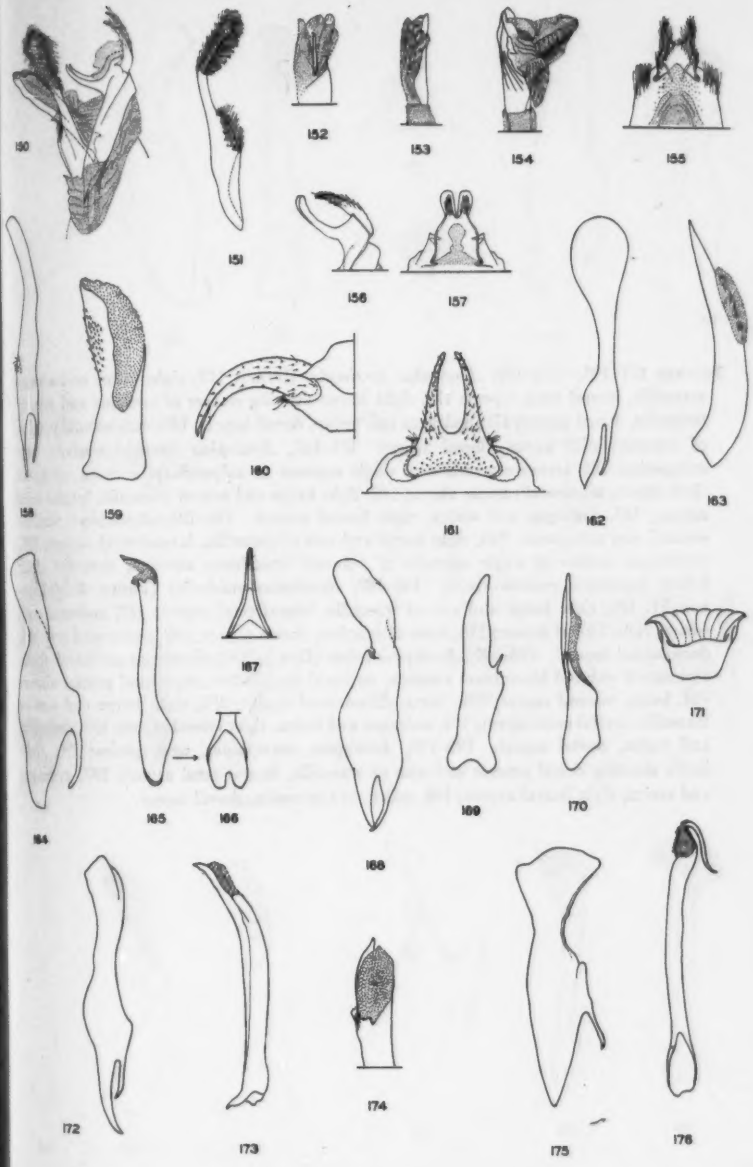
FIGURES 150-176.—150-157, *Acrolophus arcanellus* (Clemens): 150, male genitalia, right lateral aspect of specimen 1; 151, left harpe, ventral aspect; 152, apical portion of aedeagus with vesica and cornutus, dorsal aspect of specimen 1; 153, apical portions of anellus, aedeagus, and vesica, left lateral aspect of specimen 1; 154, apical portions of anellus and aedeagus showing extruded vesica and cornutus, dorsolateral aspect of specimen 2; 155, dorsocaudal portion of tegumen with uncus, dorsal aspect of specimen 1; 156, uncus and gnathos, lateral aspect of specimen 2; 157, uncus and gnathos, dorsal aspect of specimen 2. 158-161, *Acrolophus morus* (Grote): 158, right harpe and arm of transtilla, lateral ectal aspect; 159, aedeagus and vesica, right lateral aspect; 160, uncus, dorsolateral aspect; 161, uncus, dorsal aspect. 162, 163, *Acrolophus forbesi*, new species: 162, right harpe and arm of transtilla, lateral ectal aspect; 163, aedeagus, vesica, and cornuti, right lateral aspect. 164-167, *Acrolophus panamae* Busck: 164, right harpe and arm of transtilla, lateral ectal aspect; 165, aedeagus and vesica, right lateral aspect; 166, basal portion of aedeagus, dorsal aspect; 167, uncus, dorsal aspect. 168-171, *Acrolophus juxtatus*, new species: 168, right harpe and arm of transtilla, lateral ectal aspect; 169, aedeagus, ventral aspect; 170, aedeagus and vesica, right lateral aspect; 171, juxta, ventral aspect. 172-174, *Acrolophus chiricahuae*, new species: 172, right harpe and arm of transtilla, lateral ectal aspect; 173, aedeagus and vesica, right lateral aspect; 174, apical portion of aedeagus with vesica, dorsal aspect. 175, 176, *Acrolophus fervidus* Busck: 175, right harpe and arm of transtilla, lateral ectal aspect; 176, aedeagus and vesica, dorsal aspect.



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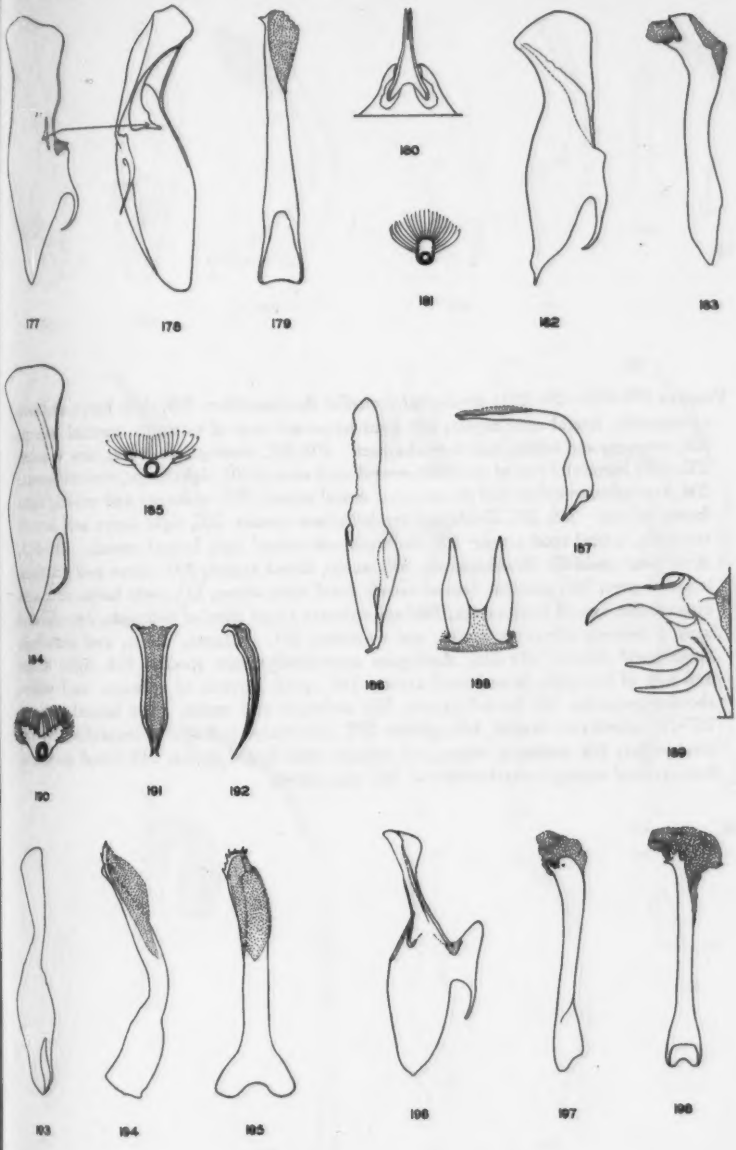
FIGURES 177–198.—177–180, *Acrolophus persimplex* (Dyar): 177, right harpe and arm of transtilla, lateral ectal aspect; 178, right harpe showing clasper of cucullus and arm of transtilla, dorsal aspect; 179, aedeagus and vesica, dorsal aspect; 180, dorsocaudal portion of tegumen with uncus, dorsal aspect. 181–183, *Acrolophus sinclairi sinclairi*, new subspecies: 181, transverse section of single segment of unipectinate antenna, antennal shaft below, segmental process above; 182, right harpe and arm of transtilla, lateral ectal aspect; 183, aedeagus and vesica, right lateral aspect. 184–185, *Acrolophus sinclairi nelsoni*, new subspecies: 184, right harpe and arm of transtilla, lateral ectal aspect; 185, transverse section of single segment of reduced bipectinate antenna, antennal shaft below, segmental process above. 186–189, *Acrolophus quadrellus* (Barnes & McDunnough): 186, right harpe and arm of transtilla, lateral ectal aspect; 187, aedeagus and vesica, right lateral aspect; 188, arms of gnathos, dorsal aspect; 189, uncus and gnathos, dorsolateral aspect. 190–195, *Acrolophus minor* (Dyar): 190, transverse section of single segment of reduced bipectinate antenna, antennal shaft below, segmental process above; 191, juxta, ventral aspect; 192, juxta, dorsolateral aspect; 193, right harpe and arm of transtilla, lateral ectal aspect; 194, aedeagus and vesica, right lateral aspect; 195, aedeagus and vesica, dorsal aspect. 196–198, *Acrolophus parvipalpus*, new species: 196, right harpe showing costal process and arm of transtilla, lateral ectal aspect; 197, aedeagus and vesica, right lateral aspect; 198, aedeagus and vesica, dorsal aspect.



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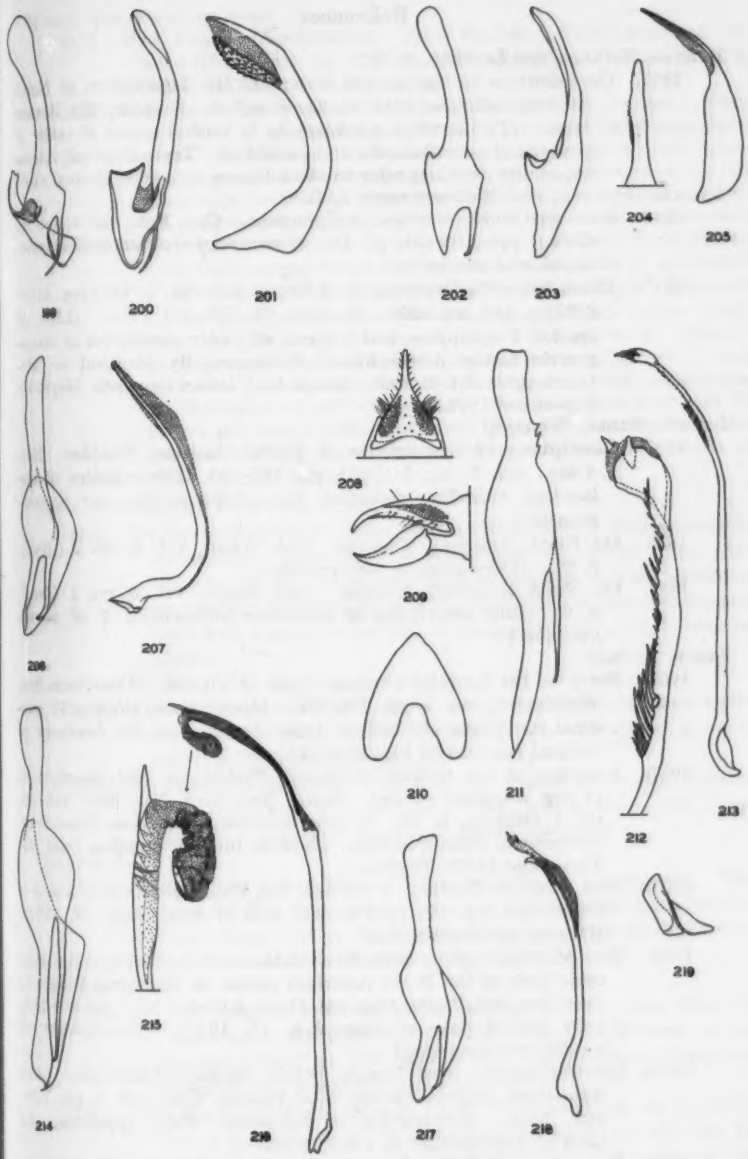
FIGURES 199–219.—199–201, *Acrolophus davisellus* Beutenmüller: 199, right harpe and arm of transtilla, lateral ectal aspect; 200, right harpe and arm of transtilla, ventral aspect; 201, aedeagus and vesica, right lateral aspect. 202–205, *Acrolophus serratus*, new species: 202, right harpe and arm of transtilla, lateral ectal aspect; 203, right harpe, ventral aspect; 204, approximate apical half of aedeagus, dorsal aspect; 205, aedeagus and vesica, right lateral aspect. 206, 207, *Acrolophus seculatus*, new species: 206, right harpe and arm of transtilla, lateral ectal aspect; 207, aedeagus and vesica, right lateral aspect. 208–213, *Acrolophus variabilis* (Walsingham): 208, uncus, dorsal aspect; 209, uncus and gnathos, lateral aspect; 210, gnathos, ventral aspect, fused apex above; 211, right harpe and arm of transtilla, lateral ectal aspect; 212, approximate apical third of aedeagus, dorsolateral aspect, showing armature, vesica, and cornutus; 213, aedeagus, vesica, and cornutus, dorsolateral aspect. 214–216, *Acrolophus macrophallus*, new species: 214, right harpe and arm of transtilla, lateral ectal aspect; 215, apical portions of aedeagus and vesica showing cornutus, left lateral aspect; 216, aedeagus and vesica, right lateral aspect. 217–219, *Acrolophus vauriei*, new species: 217, right harpe and arm of transtilla, lateral ectal aspect; 218, aedeagus, vesica, and cornuti, right lateral aspect; 219, fused gnathos, lateroventral aspect, ventral surface at left, apex above.



For Explanation See Opposite Page.

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DYAR, H. G.

1895. *Eutheca* (*Sapinella*, Kirby) *mora*, Grote. Can. Ent., vol. 27, no. 1 (Jan.), p. 15. (Dyar publishes a note from Walsingham placing this species in the Anaphorinae, genus *Pseudanaphora*, and close to *arcanella*.)

1900a. Notes on some North American species of Tineidae. Can. Ent., vol. 32, no. 10 (Oct.), pp. 305–311. (Description of *cockerelli*, validation of *quadripunciellus* and *confusellus*, and introduction of *filicornis* into the literature as a misspelling.)

1900b. New species of Anaphorinae. Can. Ent., vol. 32, no. 11 (Nov.), pp. 326–328. (Descriptions of *barnesii*, *persimplex*, *piger*, and *dorsimacula*.)

1903a. A list of North American Lepidoptera and key to the literature of this order of insects. U.S. Nat. Mus. Bull. 52, p. 488, no. 5469, pp. 577–579, nos. 6577–6603, 1902 (actual date of issue: Jan. 13, 1903). (An important catalogue containing bibliographical references to original descriptions, including those of the then known 27 species of Acrolophidae. Prepared with assistance of Fernald, Hulst, and Busck. Contains "description" of *davisellus* subspecies *minor* at no. 6601a.)

1903b. List of Lepidoptera taken at Williams, Arizona, by Messrs. Schwarz and Barber. Proc. Ent. Soc. Washington, vol. 5, p. 232 (Feb.). (Description of *unistrigana*.)

1903c. A new anaphorid, and a note on an old one. Can. Ent., vol. 35, no. 3 (March), p. 76. (Description of *kearfotti*.)

EYER, J. R.

1924. The comparative morphology of the male genitalia of the primitive Lepidoptera. Ann. Ent. Soc. Amer., vol. 17, no. 3, pp. 275–328, text figs. 1–10, pls. 25–38. (Family Acrolophidae is here diagnosed and taxonomically placed on basis of ♂ genital structure. Genitalia of several North American species figured.)

1926. Characters of family and superfamily significance in the male genitalia of Microlepidoptera. Ann. Ent. Soc. Amer., vol. 19, no. 2, pp. 237–246, pls. 18, 19. (Family Acrolophidae again diagnosed and systematically placed on basis of ♂ genitalia.)

FERNALD, C. H.

1888. A revision of the genera *Acrolophus*, Poey, and *Anaphora*, Clem., by The Right Honorable Lord Walsingham. Ent. Amer., vol. 3, no. 10, pp. 195–196. (A brief review of Walsingham's revision of 1887. Fernald reproduces Walsingham's key to the genera of Anaphorinae. Material in this article is not referenced since it is already covered by the Walsingham references.)

FORBES, S. A.

1890. The burrowing web worm, *Pseudanaphora arcanella*, Clem. In sixteenth report of the state entomologist on the noxious and beneficial insects of Illinois, pp. 98–101, figs. 1–3, 5, pl. 6. (The fifth report of Forbes, covering the years 1887–1888. Larval habits mentioned on p. 98, larva described on p. 99, imago described on p. 100, and imago of *mortipennella* described on p. 101.)

1905. The burrowing web-worms, *Anaphora popeanella* Clem., *Pseudanaphora arcanella* Clem., and *Hypoclopus mortipennellus* Grote. In twenty-third report of the state entomologist on the noxious and beneficial insects of Illinois, pp. 44, 95–98, figs. 24, 76–78. (The twelfth report of Forbes. Discusses appearance and habits of above as larvae, mentioning their injury to young corn.)

FORBES, WILLIAM T. M.

1923. The Lepidoptera of New York and neighboring states (primitive forms: Microlepidoptera, Pyraloids, and Bombyces). Cornell Univ. Agr. Exp. Station Mem. 68, pp. 12, 15, 25, 50, 53, 115–117, 119–122, figs. 19, 87, 91, 93–98. (Diagnoses group as subfamily Acrolophinae and gives characters and keys for larva, pupa, and adult. Keys and discusses 15 eastern species.)

GROTE, A. R.

1872a. Descriptions of two species of *Anaphora*. Can. Ent., vol. 4, no. 7 (July), pp. 136–138. (Descriptions of *mortipennella* and *agrotipennella*.)

1872b. Description of the female of *Anaphora agrotipennella*. Can. Ent., vol. 4, no. 8 (Aug.), pp. 142–143. (Description of ♀ *agrotipennella*.)

1881. North American moths, with a preliminary catalogue of the species of *Hadena* and *Polia*. Bull. U.S. Geol. & Geogr. Surv. Terr., vol. 6, no. 2, art. 10, pp. 257–258 (Sept.). (Descriptions of *Eutheca* and *mora*.)

1886. On the geographical distribution of North American Lepidoptera. Can. Ent., vol. 18, no. 10, p. 199. (Grote states: "In Alabama, aside from the Cotton Moth, it was at certain times hardly possible for me to read at night by light for the swarms of *Acrolophus agrotipennella* and *mortipennella*, which fluttered over the table and the page.")

HAIMBACH, FRANK

1915. New Heterocera (Lep.). Ent. News, vol. 26, no. 7 (July), p. 325, fig. 11, pl. 12. (Description of *buckella*.)

HOLLAND, W. J.

1903. The moth book, a popular guide to a knowledge of the moths of North America, p. 443, figs. 42 and 43, pl. 48. New York: Doubleday, Page & Co. (Color photograph of two species—*arcanellus*, mislabeled as *popeanella*, and *plumifrontellus*.)

KAYE, W. J.

1925. New species and subspecies of Trinidad Rhopalocera and Heterocera. Trans. Ent. Soc. London, 1924–1925, p. 428, fig. 2, pl. 45. (Color reproduction of half specimen of *fervidus*.)

KEARFOTT, W. D.

1907. New Micro-Lepidoptera. Can. Ent., vol. 39, no. 1 (Jan.), p. 9. (Description of *crescentella*.)

KIRBY, W. F.

1892. A synonymic catalogue of Lepidoptera Heterocera (moths), vol. 1, p. 524. Sphinges and Bombyces, London. (New name, *Sapinella* Kirby, replacing preoccupied generic name, *Eutheca* Grote.)

MCDUNNOUGH, J. H.

1939. Check list of the Lepidoptera of Canada and the United States of America. Part II, Microlepidoptera. Mem. Southern California Acad. Sci., vol. 2, no. 1, pp. 103–104, nos. 9540–9585, 9598. (Lists 46 species, 6 synonyms, and 1 form, all under *Acrolophus* in monogeneric family, Acrolophidae. Places family between Psychidae and Tineidae in superfamily Tineoidea.)

MERRICK, H. D.

1901. [No title]. Proc. Ent. Soc. Washington, vol. 5, no. 1, p. 40. (A note on several specimens of *mora* taken at New Brighton, Pa., on Oct. 12, 1901.)

MEYRICK, EDWARD

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MURTFELDT, M. E.

1876. Larva of *Anaphora agrotipennella*. Can. Ent., vol. 8, no. 10, pp. 185–186. (Description of larva and its habits. Pupa briefly described.)

PIERCE, F. N.

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1914. The genitalia of the group Geometridae of the Lepidoptera of the British Islands: an account of the morphology of the male clasping organs and the corresponding organs of the female, xxix+ 88 pp., 48 pls. Liverpool. (Well illustrated pioneer work on morphology and terminology of lepidopterous genitalia. Partially adopted for present revision.)

POEY, FELIPE

1832. Centurie de Lépidoptères de l'île de Cuba . . ., pp. 51–53, pl. 20 (July). Paris. (Description of *Acrolophus*. Text in French and Latin.)

RILEY, CHARLES VALENTINE

1888. An important contribution to lepidopterology, *in* Insect Life, vol. 1, no. 6, p. 195. U.S. Dept. Agric., Div. of Ent., Periodical Bull. (A brief review of Walsingham's revision of 1887. A tabulation of then known North American genera and species, as recognized by Walsingham, is given. Material in this article is not referenced since it is already covered by the Walsingham references.)

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SMITH, JOHN BERNHARDT

1891. List of the Lepidoptera of Boreal America, p. 90 (no. 4770), pp. 94–95 (nos. 5043–5066), p. 112. Publ. Amer. Ent. Soc., Philadelphia. (Smith, assisted by Skinner, Hulst, Fernald, and Riley, covered all known Lepidoptera north of Mexico. Lists 24 species, 3 synonyms, and 1 form among 8 genera under family Anaphoridae. Group placed under Tineina between the Choreutidae and Taleporidae. Lists Beutenmüller's manuscript names, *confusellus* at no. 5056 and *quadripunctellus* at no. 5057.)

WALSINGHAM, LORD THOMAS DE GREY

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1884. North American Tortricidae. Trans. Ent. Soc. London, 1884, p. 133 (April). (Descriptions of *Pseudoconchylis* and *laticapitana*.)

1887a. A revision of the genera *Acrolophus*, Poey, and *Anaphora*, Clem. Trans. Ent. Soc. London, 1887, pp. 137–173 (June), pls. 7 and 8. (Descriptions of *Neolophus*, *furcatus*, *maculifer*, *Hypoclopus*, *griseus*, *Ankistrophorus*, *cervinus*, *arizonellus*, *morrisoni*, *propinqua*, *tenuis*, *macrogaster*, *Felderia*, *filicicornis*, *Ortholophus*, *variabilis*, and *Pseudanaphora*.)

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1907. Descriptions of new North American tineid moths, with a generic table of the family Blastobasidae. Proc. U.S. Nat. Mus., vol. 33, p. 228 (Oct.). (Description of *coloradellus*.)

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